Logistics Management Institute

Joint Logistics Over the Shore — An Assessment of Capabilities

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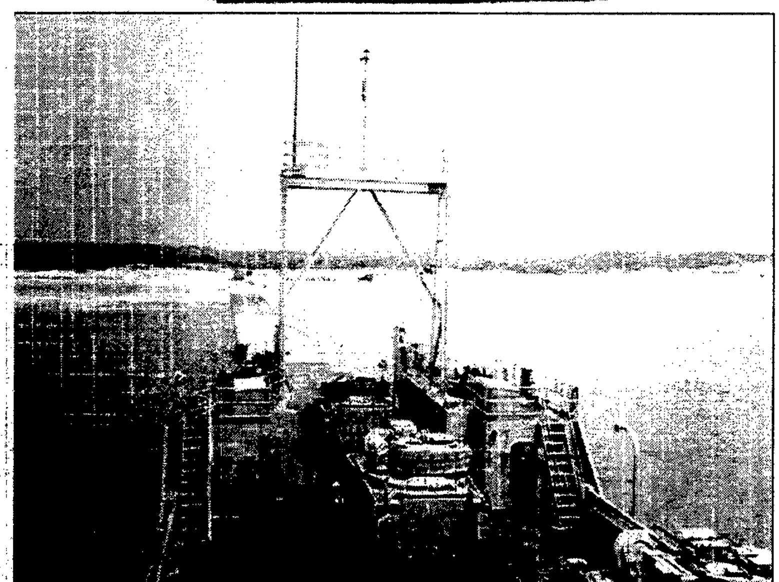

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Executive Summary

The revised U.S. national military strategy for power projection requires a responsive Joint Logistics Over the Shore (JLOTS) capability in support of the Regional Unified Commands. In military contingencies, that capability is earmarked for an early, critical role in the reception and onward movement of reinforcing forces deployed from the continental United States. The Army, Navy, and Marine Corps have designed, trained, and equipped their logistics over the shore forces to perform Service missions in support of the unified command requirements and, together, those forces form the DoD JLOTS capability available to the unified commands. Each Service has unique capabilities and, when combined, those capabilities offer the combatant commanders in chief (CINCs) a potent and flexible JLOTS option in maneuver warfare. At the request of the Director for Logistics, The Joint Staff, the Logistics Management Institute evaluated the JLOTS program relative to CINC requirements.

In our evaluation, we used cargo throughput information furnished by the Regional Unified Commands at the request of the U.S. Transportation Command (USTRANSCOM). Each Regional Unified Command provided the U.S. Transportation Command with initial estimates of its JLOTS requirements, and we used those estimates as the basis for this evaluation. We translated those initial requirements into JLOTS force packages, or combinations of the various lighters needed to perform each regional mission. Using craft that we assumed to be available, we modeled JLOTS operations with our Joint Over the Shore Transportation Estimator, a powerful linear programming model that selects the mix of lighters best suited to perform a specific JLOTS mission.

The results of Joint Over the Shore Transportation Estimator modeling and our assumptions lead us to conclude that DoD could reasonably meet the requirements of four of the five regional CINCs for a JLOTS force.

We further concluded that tailoring the JLOTS force by selecting a mix of lighters best suited to perform each CINC's mission is essential. We found the most efficient JLOTS operation to be one that uses Navy causeways plus the Army's Logistics Support Vessel (LSV) and Landing Craft, Utility-2000, in combination, particularly when the ratio of tracked and wheeled vehicles is high.

Positioning the JLOTS force to conduct operations most effectively requires exploring a number of alternatives to enhancing the afloat prepositioning concept. An important consideration for coordinating the integration of Service LOTS forces is how early in the deployment phase they are needed to support a unified command. Some alternatives examined include early movement or

positioning of lighters, use of additional float-on/float-off ships, establishment of a program for area-specific prepositioning, and forward stationing or forward deploying selected craft.

We considered the consequences of reduced logistics throughput with current JLOTS equipment in Sea State 3 or higher (where today's JLOTS would be effectively halted). While operational means can be used to some extent to offset the effects of sea conditions, we look to promising near-term technology to significantly enhance productivity and cargo throughput capability.

The force structure needed to support fixed port and JLOTS operations is heavily weighted to the Army and Navy Reserve Components. In a single major regional contingency, a significant portion of the force structure needed to receive the early arriving force – from lighter crews to cargo-handling units – comes from the Reserve Components.

A coordinated Army and Navy effort is needed to meet CINC JLOTS requirements. Our assessment underscores the need for early Service and CINC planning decisions to place the most capable and interoperable JLOTS force in position as soon as possible to support unified command operations. These decisions will require continued Service and unified command coordination on deployment, stationing, and force structuring options.

We present the following 11 recommendations for providing a responsive JLOTS capability in support of the Regional Unified Commands.

The single most important recommendation from our evaluation is that the JLOTS force needs to be trained in a joint environment. While much has been done to designate candidate Joint Chiefs of Staff-sponsored exercises for bringing together a joint team in a realistic unified command setting, continued support by the unified commands and the Services is essential to fully implement a JLOTS training program. Since each Regional Unified Command has identified a JLOTS requirement, the CINCs and their Component commanders are now in a position to focus on regional JLOTS training opportunities. Every opportunity should be taken to integrate JLOTS forces into regional exercises. Where JLOTS is a key element in a unified command concept plan or operations plan, frequent training will hone critical perishable skills of the joint team.

Further, the Director for Logistics, The Joint Staff, should recommend the following actions:

1. That the Army accelerate the leasing process to obtain a second float on/float off ship to carry lighters, harbor craft, and floating craft for the Army Theater Opening Force Modules. These watercraft packages are designed to support operations ranging from humanitarian relief to a major regional contingency. U.S. Transportation Command should consider in-place lease agreements to obtain two additional FLO/FLO ships during crises.

2. That the Army assess the need to forward-station heavy boat assets in areas in which their early demand cannot currently be met through self-deployment or by strategic sealift assets.

3. That USTRANSCOM, Regional Unified Commands, and the Services develop coordinated fixed port and JLOTS support packages to meet CINC concept plan and operations plan requirements.

4. That USTRANSCOM, Regional Unified Commands, and the Services develop procedures for the early lift (strategic sealift and movement to the objective area) of watercraft and JLOTS force packages (crews, cargo handlers, and maintainers).

5. That the Regional Unified Commands identify the requirement for JLOTS forces in time phased force deployment data developed in conjunction with deliberate planning processes. Development of such data includes identifying a requirement for strategic sealift to move the JLOTS force packages (craft, personnel, and equipment).

6. That the Army and Navy assess the adequacy of their logistics over the shore and fixed port force structures in meeting unified command requirements. That assessment should include a determination of the effectiveness of the current mix of Active and Reserve Component forces.

7. That the Army focus its second-generation modular causeway procurement effort on the roll-on/roll-off discharge facility and floating causeway pier as enhancers for the current fleet of Logistics Support Vessels and landing craft.

8. That the Navy obtain the Air Cushioned Vehicle Landing Platform to provide the Landing Craft, Air Cushioned with a fly-on/fly-off platform that enables that craft to operate in a JLOTS environment.

9. That the Navy use its operational evaluation program to determine the ability of the new Modular Elevated Causeway System to meet unified command requirements.

10. That the Navy and the Advanced Research Projects Agency aggressively pursue research, development, test and evaluation for the Landing Ship Quay/Causeway, the Advanced Modular Causeway Lighterage System, and the robotic crane technology for auxiliary crane ships.

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CHAPTER 1

Introduction

BACKGROUND

At the request of the Director for Logistics, The Joint Staff, the Logistics Management Institute analyzed DoD's capability to provide joint logistics over the shore (JLOTS) in support of Regional Unified Commands. Logistics over the shore (LOTS) is defined[1] as follows:

> ". . . the loading and unloading of ships without the benefit of fixed port facilities in either friendly or undefended territory and, in time of war, during phases of theater development. LOTS operations are conducted over unimproved shorelines, through fixed ports not accessible to deep draft shipping, and through fixed ports that are not adequate without the use of LOTS capabilities."

As the definition implies, the range of possible JLOTS employment options requires great flexibility in the floating craft and lighters that establish the critical link between sealift ships offshore and military ground elements ashore.

Today, in the continental United States (CONUS), deployment has improved greatly with enhancements to the infrastructure (installation of rail and container facilities and acquisition of railcars, containers, and container-handling equipment), the development of modern fixed ports of embarkation [commercial deep draft seaports with container and roll-on/roll-off (RO/RO) berths and the expansion of the West Coast ammunition capability], and the acquisition of adequate fast sealift (large, medium-speed RO/RO ships and militarily useful ships in the Ready Reserve Force). Unified commanders can now reasonably expect to meet their established time lines for receiving equipment and supplies overseas. However, we cannot simply assume that modern overseas port facilities with state-of-the-art cargo handling infrastructure will always be available to U.S. forces arriving in a theater of operations. The need for rapid deployment of heavy forces using large, fast sealift ships means that access to a number of world ports may be restricted simply because of the size and draft of those ships. JLOTS sea/land interface is most critical when port accessibility is restricted or denied. It provides the unified commander an important alternative for employing and sustaining maneuver forces.

The DoD requirement for a responsive JLOTS capability is clearly seen in the post-Cold War era as the Regional Unified Commands develop plans in response to an array of contingencies. From the outset of the Persian Gulf War to Haiti, increasing emphasis has been placed on JLOTS and JLOTS-capable craft in

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[1] Joint Chiefs of Staff, Joint Pub 4-01.6, *Joint Tactics, Techniques, and Procedures for Joint Logistics Over the Shore.*

scenarios ranging from major regional contingencies (MRCs) to smaller, quick reaction peacekeeping and humanitarian operations.

Both the Army and Navy have LOTS capabilities. Each has unique missions for which its forces are structured and equipped. The Navy LOTS process is focused on sustaining Marine amphibious forces in support of a unified commander's operation. The Army centers its efforts on theater logistics support and intracoastal transportation operations. When combined, elements from the two Services would form the JLOTS force supporting the unified commander.

The ability to employ JLOTS systems in Sea State (SS) 3 or greater conditions is a major operational consideration. Weather and sea state conditions are the single most significant variables in cargo throughput calculations. As sea state increases, the ability of sealift ship cranes and ramps to interface with causeway discharge platforms and smaller lighters decreases because of the effect wave and wind action have on the ships, causeways, and lighters. Joint Pub 4-01.6 defines SS3 as a moderate sea with large wavelets having a significant wave height of 3.5 to 5 feet with breaking crests and winds of 13.6 to 16.3 knots. Some JLOTS systems (particularly causeways that act as discharge platforms or ferries) cannot safely and effectively transfer cargo under those conditions. In fact, their capability begins to decline in SS2. Thus, in compensation for lost time, today's JLOTS forces must maximize cargo throughput while seas are calm. The JLOTS community is seeking new technology solutions to overcome this limitation.

In 1990, one of the more important DoD JLOTS initiatives was the creation of the JLOTS Joint Test Directorate (JTD) chartered by the Under Secretary of Defense (Acquisition) and sponsored by the U.S. Transportation Command (USTRANSCOM). The JTD quantified the capabilities of the Services in performing JLOTS operations. It conducted three JLOTS tests (JLOTS I, JLOTS II, and JLOTS III), culminating in the JLOTS III OCEAN VENTURE 93 (OV93) demonstration at Camp Lejeune, N.C. The *JLOTS III Throughput Test Report*[2] from OV93 provides good insight into how the Services train and equip their LOTS forces and into operational deficiencies in JLOTS equipment and training.

In 1993, TRANSCOM undertook a major effort to identify and define regional commander in chief (CINC) JLOTS requirements. That work, coupled with the work of the JLOTS Joint Integration Office (JIO) and JTD JLOTS test results, has been most effective in providing visibility to the JLOTS program. It has led to a better understanding of JLOTS throughput requirements, force structure issues, capabilities and employment options, and training requirements, and has clarified the need to leverage emerging technology in seeking solutions for overcoming the SS3 barrier.

Another significant initiative was the creation, in 1994, of the JLOTS JIO under J-4, of the Joint Staff. The JLOTS JIO Working Group, composed of Service and unified command representatives, has brought together Service LOTS experts and CINC planners in an exchange of information on Service programs

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[2] U.S. Transportation Command, Joint Test Directorate, JLOTS III Throughput Test, Ocean Venture 93, May 1994.

and CINC initiatives. The JLOTS JIO Working Group is addressing common areas of interest such as training, R&D, and acquisition and is developing a coordinated approach in meeting unified command JLOTS throughput requirements.

In this document, we present our JLOTS assessment, which draws on earlier work performed by TRANSCOM. In 1993, USTRANSCOM requested that each of the Regional Unified Commands review their need for a JLOTS capability and provide a summary of cargo movement requirements. The five Regional Unified Commands [U.S. Atlantic Command (USACOM), U.S. Central Command (USCENTCOM), U.S. European Command (USEUCOM), U.S. Pacific Command (USPACOM), and U.S. Southern Command (USSOUTHCOM)] identified JLOTS requirements ranging from operations other than war (OOTW) to MRCs. The results of this earlier effort were briefed by TRANSCOM to the Improving Force Closure — General Officer Steering Committee (IFC-GOSC) in May 1994. The core of our assessment is unified command JLOTS requirements as defined in that briefing. We compare those requirements with Service capabilities. We look at both LOTS systems and force structure from the viewpoint of joint support to the Regional Unified Commander. Another important feature of our evaluation is the potential impact on JLOTS capability from continuation of current Service programs. We also look at possible future capability from programs employing emerging technology.

In a supplement to this report, we present two classified appendices with briefing charts and other information used in our evaluation. Unified command JLOTS requirements (including the most recent refinements) and the TRANSCOM IFC-GOSC briefing charts are found at Appendix E of the supplement (classified SECRET — NOFORN).

Appendix F (also classified SECRET — NOFORN) contains charts on the summaries of scenario-based JLOTS requirements reported by the unified commands. That appendix includes operational assumptions drawn from current Service capability and Mobility Requirements Study — Bottom Up Review Update (MRS-BURU) data. Where applicable, we translated those data using the Model for Intertheater Deployment by Air and Sea (MIDAS) for our Joint Over the Shore Transportation Estimator (JOTE) to obtain modeling results. We developed the JOTE to determine lighter requirements for LOTS missions. The JOTE model is described in Appendix B along with a detailed presentation of the assumptions used in our analysis.

Appendix C provides briefing charts prepared for the Joint Staff upon which this report is based. It also incorporates the latest information available on Service programs and uses comments and clarifications from earlier versions briefed to the JLOTS JIO and Joint Warfighting Capabilities Assessment Working Groups.

Finally, we include a description of the lighters used in this evaluation along with notional drawings of a fixed port and JLOTS operation at Appendix D.

The JOTE Model

The Logistics Management Institute (LMI) JOTE model is an operational planning tool for JLOTS operations. It determines over-the-shore productivity using ship-to-shore discharge lanes defined in terms of RO/RO tracked vehicles, RO/RO wheeled vehicles, lift-on/roll-off (LO/RO) for both tracked and wheeled vehicles, and lift-on/lift-off (LO/LO) containers. We determine the number of discharge lanes by the type of ship being discharged, whether a RO/RO discharge facility (RRDF) or auxiliary crane ship (T-ACS) is used, and the number and type of lighters available. After reviewing planning factors from Joint Pub 4-01.6 and the JLOTS II and the OV93 JLOTS III tests, we identified complete cycle times, along with cargo-carrying capacity for the various lighters. In all cases, we selected planning factors on the basis of empirical data determined through JLOTS testing. Those planning factors translate into how much tonnage the lighters can move by lane in a 20-hour, two-shift day. After determining lighter productivity and defining JLOTS requirements, JOTE selects the lighter most suitable to perform specific cargo transfer functions. The model also provides information on the number of lighters used, the number of trips required, and finally, whether the cargo can be discharged in the allotted time. Figure 1-1 is a schematic representation of the model.

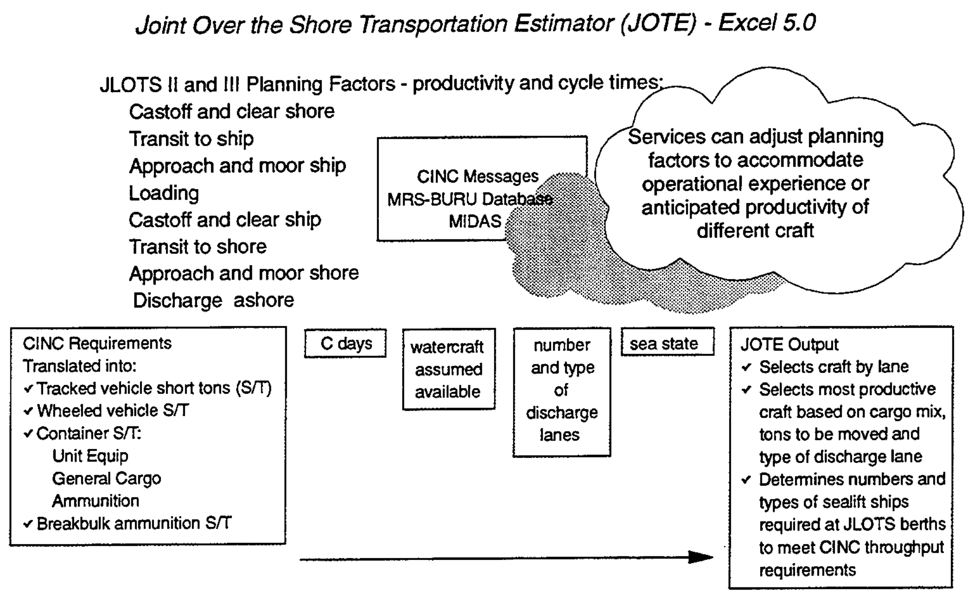

Figure 1-1.
JOTE Modeling

Modeling Assumptions

In our evaluation of the future direction of the DoD JLOTS program, we made several scenario-based operational assumptions, that with the JOTE modeling results, provided the data upon which our analysis is founded. The assumptions include the existence of a uniform requirement and capability measurement methodology, the coordination and integration of Service LOTS capability, the capability of some craft to self-deploy to an objective area, and the early positioning of JLOTS assets to meet unified command requirements. From these assumptions, a uniform methodology is available for examining each requirement. Modeling assumptions are specific to the scenarios and requirements of each Regional Unified Command. In the analysis presented in Chapter 2, we refer to the unified commands as CINC 1 through CINC 5 to keep this portion of the report unclassified. The JOTE model and our assumptions are described in detail in Appendix B.

Chapter 2

JLOTS Analysis

Modeling the relative productivity of the various lighters against specific CINC JLOTS missions using our JOTE model was only one of the elements of this analysis. A number of other contributing factors affect the ability of the Services to support the unified commands, and we have integrated those factors into our overall assessment. Together, the following evaluation areas comprise the assessment:

- Analysis of requirements and Service capabilities
- Acquisitions and retirements
- Sea state and capability
- Force structure
- Interoperability
- Research, development, test, and evaluation (RDT&E) and emerging technology
- Deployability.

Analysis of Requirements and Service Capabilities

The five Regional Unified Commands provided JLOTS requirements that varied from 25,000 to 1,300,000 short tons. In many cases, the unified commands had never before quantified a JLOTS requirement, and the data were not specified in the time phased force deployment data (TPFDD) cargo-level detail that will be required for crisis planners to anticipate JLOTS requirements and model them accurately. As the refinement process matures, the analyses should focus on specific scenarios: cargo-level detail for the halting, defensive, and counterattack phases; liquid cargo; and follow-on resupply container and breakbulk requirements.

We noted three important factors in assessing unified command JLOTS requirements relative to Service capabilities. First, the scenario development and cargo-level detail refinement process (for both dry and liquid cargo) are critical to all follow-on Service and CINC programming and planning initiatives. In the case of CINC 5, a refinement of JLOTS requirements is necessary. CINC 5's throughput requirements cannot reasonably be met under the assumptions of this assessment (i.e., cargo throughput requirement and the prevailing sea state conditions). If the CINC 5 requirements are validated, a program will have to be developed to increase Service capability. Recent information obtained from CINC 5 planners, however, indicates that the daily JLOTS throughput requirement may, upon refinement, be significantly reduced. Our analysis is based on the data CINC 5 originally provided to TRANSCOM.

Second, JLOTS testing has demonstrated efficiencies in the use of either Navy or Army causeway systems to construct RRDFs and floating causeway piers. Those lighter interface systems allow the expanded utilization of Logistics Support Vessels (LSVs) and landing craft in moving tracked and wheeled vehicles ashore. For RO/RO ships capable of using an RRDF, cargo throughput can be doubled simply by adding a minimum of two RO/RO discharge lanes to the standard complement of crane liftoff lanes. Thus, the RRDF and floating causeway pier are key components in meeting JLOTS throughput requirements for the early entry force.

The Navy is currently assessing how best to incorporate the Landing Craft, Air Cushioned (LCAC) and the Landing Craft Utility (LCU)-1600 into its LOTS or JLOTS operations. Those lighters are assigned to Assault Craft Units supporting the Amphibious Task Force (ATF). Since they are amphibious-delivery platforms, release of either the LCAC or LCU-1600 to perform JLOTS missions will depend on the situation. Both lighters can be valuable additions to the JLOTS capability although the LCAC can be most effective when operating farther from shore than do conventional craft. In LO/LO operations, the LCAC is less capable than conventional craft. The LCU-1600 or the causeway ferry are better suited for that method of cargo discharge.

Third, Service capabilities were combined in modeling four of the five unified command JLOTS operations. Since each Service has unique LOTS capabilities, providing the most potent and flexible JLOTS force requires the early integration of Service capabilities. Specifically, the Navy has a large fleet of causeway ferries that are well suited for transporting containers; the Army currently has no such causeways in its inventory. Conversely, the Army currently has the LSV and LCU-2000 vessels that are best employed transporting tanks and other rolling stock. Although current Service doctrine does not routinely call for JLOTS support when either Marine or Army forces are operating separately, employing the LOTS forces of both Services to meet a single Service throughput requirement may be the most appropriate action. Examples would be using Army LSVs and LCU-2000s to support the ATF once the landing force is ashore or using Navy causeway ferries to support the discharge of Army containers. Our JOTE modeling of unified command JLOTS requirements showed that the Navy has sufficient Navy lighterage (powered causeways) to perform the JLOTS and assault follow-on echelon causeway ferry mission. The Army, on the other hand, can best enhance operations with its top producers (the LSV and LCU-2000) by focusing on procurement of Army modular causeway RRDFs and piers. In that situation, the concern or Services' caution in relying on a single capability may be based on the question of whether being assigned the causeway ferry mission would detract from the Navy's ability to support to the ATF or the Army's support to the Afloat Prepositioned Force (APF). However, it may also be a question of whether each of the Services should have a distinct causeway ferry capability geared to its separate, organic support requirements. When the Army acquires and fields causeway ferries, it will have the same capability as the Navy but with different systems. Ultimately, it would be beneficial to base acquisition programs on a combined capability that capitalizes on the most efficient delivery platforms of each Service. For the present, thorough JLOTS planning is necessary to incorporate the most effective lighters in CINC operations, particularly when the Service Components are operating from separate locations.

The results of JOTE modeling for each of the unified command JLOTS requirements are provided in the following subsections.

CINC 1

Cargo weighing 25,520 short tons is to be moved over a period of four days (in this case, four days was our planning assumption). The breakdown of unit equipment and containers to be moved per day is tabulated below:

Cargo	Weight (short tons)
Tracked vehicles	614
Wheeled vehicles	2,495
Containers	3,272
Daily total	6,381

The exact location of the JLOTS mission will be determined at the time the plan is executed. For our analysis, we selected a potential site in the unified commander's area of operation. The sea condition at the location we selected averages SS2 or higher 60 percent of the time. During the four-day discharge operation, four ships (two RO/RO and two containerships) were anchored off the coast, and each ship constituted a JLOTS berth. Two T-ACS were identified to discharge the containerships and transfer containers to lighters. As we did with all other unified commands, we assumed that shipboard cranes, causeway RRDFs and floating causeway piers, and lighters would be operational and available 85 percent of the time. Lighters assumed to be available to the JLOTS commander included those that are routinely loaded aboard the ships involved, those available in the theater, and those that can arrive in the objective area from CONUS. The following tabulation shows the craft we assumed to be available and then selected by the JOTE model to meet CINC 1 requirements.

Lighter	Assumed available	JOTE selected	Not used
LSV	2	2	—
LCU-2000	18	18	—
LCU-1600	3	3	—
LCM-8	8	0	8
CSP+3	—	—	—
CSP+2	4	4	—
CSP+1	—	—	—

Note: LCM = Landing Craft, Mechanized; CSP = Causeway System, Powered.

The analysis shows that the CINC 1 JLOTS requirement of 6,381 short tons per day can reasonably be met with the ships and lighters assumed available for the operation. Even though the prevailing average sea state is higher than desired, sufficient discharge lanes (15) can be established to complete the operation in the time allotted. However, as part of the RO/RO operation, an RRDF and causeway pier must accompany the lighters or the T-ACS deployed from CONUS. The second RRDF is assumed to be loaded aboard one of the two RO/RO ships, a prepositioned ship.

CINC 2

The requirements of CINC 2 are to move 6,666 short tons per day for a 10 day period. While JLOTS will continue throughout the length of the CINC 2 operation, this is the most demanding period. The tabulation below shows a breakdown of the unit equipment and containers to be handled daily.

Cargo	Weight (short tons)
Tracked vehicles	890
Wheeled vehicles	2,630
Containers	3,146
Daily total	6,666

We identified two locations for JLOTS operations. The average sea state at both locations is SS2 or higher 52 percent of the time. Four ships will be at JLOTS berths for simultaneous discharge – two RO/RO and two containerships. As with CINC 1, two T-ACS were used to offload the containerships. Operational availability is again 85 percent. All lighters are either loaded aboard prepositioned ships or deploy from CONUS. The craft that we assumed available and were then selected by the JOTE model to meet CINC 2 requirements are shown in the tabulation below.

Lighter	Assumed available	JOTE selected	Not used
LSV	2	2	—
LCU-2000	18	13	5
LCU-1600	4	—	4
LCM-8	8	0	8
CSP+3	—	—	—
CSP+2	16 (27)[1]	12	4
CSP+1	—	—	—

[1]The number 16 followed by 27 in parenthesis indicates 11 of the 27 CSP+2 were withheld from the total available for JLOTS to perform on-call U.S. Marine Corps missions.

The CINC 2 requirement of 6,666 short tons per day can readily be met, given the prevailing sea condition and the ships and lighters assumed available daily for this operation. Fourteen discharge lanes are needed. In addition to the RRDFs loaded aboard prepositioned ships, one more RRDF and a floating causeway pier can accompany the T-ACS or deploying lighters.

CINC 3

The CINC 3 requirements call for 7,000 short tons to be moved daily during the most demanding 20-day period in the JLOTS operation. The cargo breakdown is shown in the following tabulation.

Cargo	Weight (short tons)
Tracked vehicles	1,610
Wheeled vehicles	4,760
Containers	630
Daily total	7,000

The JLOTS process will be used to augment the fixed port operation, with cargo being transferred from ships at anchor to a pier in the harbor. Sea conditions average SS2 or greater 43 percent of the time. All lighters either self-deploy to the JLOTS site or are loaded aboard prepositioned shipping. Two RO/RO ships and one containership were required at anchor daily to move the 7,000 short tons. A T-ACS will be used in conjunction with container discharge. Tabulated below are the lighters assumed available and then used by the JOTE model to meet CINC 3 requirements.

Lighter	Assumed available	JOTE selected	Not used
LSV	2	2	—
LCU-2000	15	10	5
LCU-1600	2	2	—
LCM-8	6	0	6
CSP+3	—	—	—
CSP+2	—	—	—
CSP+1	—	—	—

The CINC 3 daily JLOTS throughput requirement of 7,000 short tons using 11 discharge lanes can be met given the ships and lighters assumed available daily for this operation. However, because of the JLOTS location and the current lack of an alternative means for delivering up to 15 LCU-2000s to that location, this lighter must self-deploy over a significant distance. In order for both the LSV and LCU-2000 to make the ocean transit and then be available in time to conduct operations, they should begin moving or be positioned early in the crisis action process. These lighters or the T-ACS will also have to deliver two RRDFs.

CINC 4

The CINC 4 requirement calls for the movement of 8,010 short tons daily during the most demanding period of this JLOTS operation. The tabulation below is a breakdown of unit equipment and containers.

Cargo	Weight (short tons)
Tracked vehicles	1,475
Wheeled vehicles	4,361
Containers	1,615
Breakbulk pallets	559
Daily total	8,010

Two JLOTS sites are used during this phase of the CINC 4 operation. The prevailing sea condition is SS2 or greater 40 percent of the time. For the operation, two RO/RO ships, one containership and one combination RO/RO and breakbulk ship were at JLOTS berths. All lighters are assumed to be either prepositioned or deployable to the area of operations. Equipment availability remains at 85 percent. The tabulation below shows the craft that we assumed to be available and then used by the JOTE model to meet CINC 4 requirements.

Lighter	Assumed available	JOTE selected	Not used
LSV	3	3	—
LCU-2000	7	7	—
LCU-1600	6	6	—
LCM-8	28	0	28
CSP+3	—	—	—
CSP+2	24 (35)[1]	8	16
CSP+1	13	0	13

[1] The number 24 followed by 35 in parenthesis indicates 11 of the 35 CSP+2 lighters were withheld from the total available for JLOTS to perform on-call U.S. Marine Corps missions.

The CINC 4 JLOTS operations require 17 discharge lanes. The RRDFs needed to perform RO/RO discharge operations are available from prepositioned assets. While the most demanding requirement of 8,010 short tons per day can be met during the second phase of the campaign, an initial shortfall of approximately 2,000 short tons per day is experienced during the first 10 days of operations. All the lighters needed to meet the initial daily throughput requirement had not yet arrived. This 10 day deficiency can be overcome by a combination of early positioning of lighters, acquiring an additional float-on/float-off (FLO/FLO) ship for prepositioning and forward-stationing or forward-deploying craft.

CINC 5

The CINC 5 requirement calls for 26,799 short tons to be moved daily for 15 days through two JLOTS sites. A breakdown of the unit equipment and containers at each site is tabulated below.

The average sea condition for both sites is SS2 or greater 47 percent of the time. Up to 16 ships are required daily at JLOTS berths — 5 RO/RO, 6 container, and 5 breakbulk. Six T-ACS are used for transferring containers to lighters. Four RRDFs are available from prepositioned assets. One more RRDF is configured

Site 1		Site 2		
Cargo	Short tons	Cargo	Short tons	Total
Tracked vehicles	3,998	Tracked vehicles	46	—
Wheeled vehicles	11,820	Wheeled vehicles	135	—
Containers	4,461	Containers	67	—
	—	Containers ammunition	1,819	—
	—	Breakbulk ammunition	4,453	—
Daily total	20,279	Daily total	6,520	26,799 S/T

using floating causeway sections not needed for ferries or piers. If required, additional RRDFs may be available with the AFOE. All lighters are assumed to be either prepositioned or deployable to the area of operations. The craft tabulated below are assumed to be available and then selected by the JOTE model to meet CINC 5 requirements.

Lighter	Assumed available	JOTE selected	Not used
LSV	3	3	—
LCU-2000	18	18	—
LCU-1600	6	6	—
LCM-8	28	6	22
CSP+3	4	4	—
CSP+2	18 (29)[1]	18	—
CSP+1	13	2	11

[1] The number 18 followed by 29 in parenthesis indicates 11 of the 29 CSP+2 lighters were withheld from the total available for JLOTS to perform on-call Marine Corps missions.

Our analysis showed a shortfall of approximately 12,500 short tons remained after the 20 productive hours of available time on the 63 discharge lanes had expired. For this requirement, sea state becomes a critical factor. While the shortfall will vary depending on the sea state at any given time, the daily requirement of 26,799 short tons clearly exceeds JLOTS capability. Two other contributing factors – the number of ships available to carry cargo in the CONUS-to-overseas theater pipeline and the number of cargo-handling units – also bring into question the ability to meet this requirement. First, enough RO/RO, container, and breakbulk ships may not be available to ensure 16 of these ships always being at JLOTS berths with the cargo required by CINC 5. We simply do not have enough sealift assets to maintain 16 ships on berth for JLOTS operations at all times. Similarly, for every JLOTS berth, one cargo-handling unit is needed. While 16 units does not exceed the total active and reserve cargo-handling capability of the Army and Navy, we must also consider that other cargo-handling units may be concurrently working in ports at other locations in the theater or in other theaters.

Thus, prevailing sea state conditions that limit the hours of operation and the probability that sufficient sealift ships of the type and quantity needed and the significant number of cargo-handling units required will not be available serve to underscore the conclusion that the JLOTS requirement is larger than the joint Service capability. If, after refinement, the CINC 5 requirement is confirmed, this location would be ideal for an Advanced Modular Causeway Lighterage System or Landing Ship Quay/Causeway (LSQ/C)-like capability should these and/or other emerging concepts prove feasible.

Summary

In summary, our analysis of the five Regional Unified Commands indicates that if sufficient forces are available and deployed, and sea state conditions do not exceed the average over extended periods for each location, the requirements of all but one unified command can be met. However, in the overall evaluation, we must consider the contributions of other areas to the ability of the Services to meet unified command JLOTS requirements.

ACQUISITIONS AND RETIREMENTS

Table 2-1 shows the combined Army and Navy inventory of JLOTS-capable lighters. The lighters in that table (less the LCAC) were used in modeling unified command requirements. While each of the Services has concentrated on its capability to move ground combat forces and sustainment supplies ashore, we see a different emphasis on the type of lighters each acquires. The Navy uses the LCAC, landing craft (i.e., LCM-8 and LCU-1600), and floating causeways (Navy lighterage) for amphibious assault and logistics support to the ATF. The Army, on the other hand, has a theater intracoastal transportation mission and has fielded a variety of craft that support both LOTS and intracoastal operations. The mainstays of Army operations are the LSV and LCU-2000.

Our analysis of CINC JLOTS requirements shows that the most effective operation is one that uses Navy causeway lighters to handle containers and palletized cargo and Army lighters to move tracked and wheeled vehicles. Table 2-1 reflects planned changes in the inventory. For the Army, some of the LCM-8s may be divested and a major program is underway to procure modular causeway systems for ferries, RRDFs, and floating piers. The Navy is continuing its procurement of LCACs for amphibious operations and plans to complete the purchase of two modular elevated causeway systems as replacement for the current ELCAS (NL). Elevated causeways are elevated piers used for handling containers and palletized cargo for the assault follow-on echelon of the ATF. Although the Army LSV and LCU-2000 can operate with the ELCAS, it is a expeditionary pier designed to moor and discharge causeway lighters and the LCU-1600.

Although Table 2-1 shows only JLOTS-capable lighters and causeways, both the Army and Navy also have a significant number of other floating craft that will be included in watercraft packages supporting the Regional Unified Commands. Tugs, floating cranes, and barges perform a number of critical missions in fixed port and JLOTS operations. Those missions include docking large strategic sealift ships, performing heavy lifts or channel clearing, and storing bulk liquid cargoes. Additionally, T-ACSs are used for the instream discharge from non-self-sustaining containerships and are critical JLOTS assets.

The Navy has developed the Modular Elevated Causeway System [ELCAS (M)] as the replacement for the current ELCAS (NL). Delivery of the first of two modular pier systems began in February 1995. The complete system is scheduled for delivery in June 1996. Assembly testing and installation time and interface with existing lighterage is being done at the Naval Amphibious Base, Little Creek, Va. The major deficiencies noted in the ELCAS (NL) (i.e., maintainability, deployability, and assembly and installation time) are to be corrected with the fielding of the ELCAS (M). Testing of the ELCAS (M) is also expected to indicate how effectively the system will support warfighting requirements, particularly in the CINC 5 area of responsibility.

Table 2-1.
The Joint Watercraft Inventory (as of December 1994)

Army	Navy
6 LSVs	91 (74+17) LCACs
35 LCU-2000s	
13 LCU-1600s	41 LCU-1600s
114 LCM-8s	26 LCM-8s
23 LARC-LXs	
Causeway equipment (modular)	Causeway equipment (Navy lighterage)
7 (1+6) RRDFs	52 Side-loaded warping tugs (SLWT)
6 (1+5) Piers	64 CSP 2+1s
9 (1+8) CSP+3s	13 CSP 1+1s
	7 RRDFs
	Elevated causeway equipment
	2 ELCASs (NL) 800 ft. ea. (or 1-1600 ft.)
	2 (1+1) ELCASs (M)

Note: A number with a plus (+) indicates acquisitions.

The Navy is also considering alternatives for constructing causeway platforms that will allow the LCAC to conduct fly-on/fly-off operations in a JLOTS scenario. The Air Cushioned Vehicle Landing Platform (ACVLAP) will be linked to the RO/RO discharge facility so that the LCAC can be loaded with vehicles driven off cargo ships. Since the ACVLAP has not yet been built, we did not use the LCAC in our modeling of CINC JLOTS requirements. (However, we conducted a subsequent analysis on use of the LCAC in a JLOTS role.)[2]

Acquisition and operations and maintenance costs for the Services' lighter inventory are shown in Table 2-2. The Army is currently investing $67 million in modular causeway procurement. The Navy has programmed $362 million to complete the current buy for 91 LCAC vessels and to procure the second ELCAS(M). Annually, the Services will expend just under $400 million in

[2] LMI Report JS502MR2, *Assessment of the Heavy Lift Landing Craft, Air Cushioned*, Peter J. Thede et al., August 1995.

operations and maintenance for lighter units and their equipment when all systems are fielded.

Table 2-2.
Inventory Investment Cost

Service	Unit	Total number of units	Craft inventory	Acquisition cost (FY95 $M)	Unit O&M cost (FY95 $M)
Army	LSV Det.	6	6 LSVs	—	12.5
	Hvy Boat Co.	5	35 LCU-2000s (1 other)	—	55.9
			13 LCU-1600		
	Med Boat Co.	4	114 LCM-8s (32 other)	—	35.6
	LARC-LX Det.	4	23 LARC-LXs	—	5.2
	MCS RRDF Det.	7	1 MCS RRDF	—	2.8
			6 MCS (pp. B-16) RRDFs	27.4	17.0 when fielded
	MCS Pier Det.	6	1 MCS Pier	—	2.7
			5 MCS Piers	25.6	13.6 when fielded
	MCS+3 Det.	9	1 MCS CSP+3	—	1.5
			8 MCS CSP+3s	14.0	12.2 when fielded
	Total Army		180 (33 other)	$67M	$159M
Navy	ACU (LCAC)	2	74 LCAC	—	74
			17 LCAC	272	17.0 when fielded
	ACU (LCU-1600)	2	35 LCU-1600s (6 other)	—	55.4
	MPSRON	3	24 LCM-8s (2 other)	—	20.6
	PHIB CB	2	52 SLWTs	—	13.3
			64 NL CSP+2s	—	32.6
			13 NL CSP+1s	—	6.6
			7 NL RRDFs	—	3.7
			2 ELCAS(NL)s	—	—
			1 ELCAS(M)s	14 complete roadway	3.4
			1 ELCAS(M)s	40	3.4 when fielded
	Total Navy	—	282 (8 other)	$326M	$229.8M
Total		—	462 (41 other)	$393M	$388.8M

Notes: 1. O&M costs include personnel; 2. Army cost data obtained from Concepts Analysis Agency cost model; 3. Navy costs obtained from: a. LCAC Program Management Office, b. NL Program Management Office, and c. LCU-1600/LCM-8 - Army CAA cost model for like units; 4. Lighter totals shown as (other) reflect those not available for LOTS missions.

Sea State and Capability

As we have seen, sea conditions affect JLOTS operations. In SS3, JLOTS operations are effectively halted. Some operations may even be degraded in the higher reaches of SS2 (below a significant wave height of 3.5 feet). Table 2-3 provides an indication of how frequently various sea state levels can be expected in the Regional Unified Command areas of operation. We used the average sea state in those regions in modeling CINC JLOTS requirements. The percentages shown reflect 12 month averages.

Table 2-3.
Sea State

Region	Percent of time SS0 – SS1	Percent of time SS2	Percent of time SS3 and above
CINC 1	40	20	40
CINC 2	48	14	38
CINC 3	57	13	30
CINC 4	60	16	24
CINC 5	53	17	30

The effects of an adverse sea state can be mitigated by increasing the number of instream JLOTS berths that employ multiple RRDFs and T-ACSs to attain higher production rates during periods of calm water. Locating JLOTS berths within a protected harbor or anchorage is also an important operational consideration. However, in the event of a firm CINC requirement to operate in higher sea states, programs to identify potential solutions for breaching the SS3 barrier must be initiated. Potential solutions are discussed subsequently in this chapter.

Force Structure

Unified command JLOTS requirements will affect force structuring decisions as the Services and CINCs coordinate their efforts to develop a capability for each region. The previous work of the Navy and Marine Corps with ATF and the Maritime Prepositioned Force (MPF) and the Army's work with Theater Opening Force Modules from the Afloat Prepositioned Force (APF) serve as the baseline for these decisions. Critical to all Services is the early call-up of Reserve Component boat- and cargo-handling units or personnel. As an example, half of the Army heavy boat force structure is in the Army Reserve, and two-thirds of the Navy's Amphibious Construction Battalion personnel needed to operate Navy causeway systems are in the Navy Reserve.

Just as coordinated planning is needed to combine Service lighter assets to meet CINC requirements, similar teamwork is necessary in performing cargo-handling missions. Here, the ratio of Active to Reserve Component units is even more heavily weighted toward the Reserve. Only 2 of 14 Navy cargo-handling battalions are Active component. For the Army, only 4 of 13 terminal service companies are currently Active units.

The force structure raises two major questions. First, is the present force structure sufficient to support the most demanding requirement under a dual-MRC scenario? Second, does the Active component have enough soldiers and sailors to meet early CINC requirements for watercraft and cargo-handling units? An important outcome of the continuing JLOTS refinement effort will be a determination of force structure needs and the most effective mix of active and reserve units. For example: CINC 5 will require the equivalent of 2.5 Army heavy boat companies, 3 LSV detachments, both Navy amphibious construction battalions (current structuring for these battalions may not allow for simultaneous dry- and liquid-cargo operations), and the equivalent of 22 cargo-handling units (operating from fixed port and JLOTS sites without host nation support).

INTEROPERABILITY

The sequence of tests conducted by the JLOTS JTD led to a series of important observations on the current posture of the Services LOTS forces. Although a number of operational and material deficiencies were recorded in the JLOTS III throughput test (OV 93), the lack of training opportunities could well have been the most important finding. Frequent and rigorous training can do much to overcome identified shortcomings. Among the other significant findings from the JLOTS III throughput test were the following:

- Army and Navy causeway systems are not standardized. The Army system is modular, easily configured, and can fit into the container cells of a containership. Thus, the system is easier to install or transport aboard any ship. Navy causeway sections, while they perform the same functions as modular units, are larger, more difficult to install and maintain, and must be loaded on deck. Thus, the number of ships on which the system can be transported is limited. Army lighter crews and vehicle drivers found the Navy RRDF and pier were not user friendly (a training issue).

- The JTD recommended that the Navy's next-generation causeway system be modular and compatible with the Army modular causeway system. The Navy is continuing to work with the Army as it develops the Advanced Modular Causeway Lighterage System.

- Fendering (bumper between systems to prevent metal-to-metal contact) for Army and Navy causeway systems was inadequate causing lighter interface problems. That deficiency was most prevalent when mooring other lighters, such as landing craft, to causeways configured as RRDFs and floating piers. In those instances, mooring or securing lighters to the platforms without adequate fendering could result in damage to platforms or lighters. The Services are funding improvements to their systems.

- The Navy elevated causeway pier, the ELCAS (NL), and its crane did not interface well with larger Army lighters, the LSV and LCU-2000. The interface problems were the inability of the crane to reach outboard containers loaded in these lighters (resulting in less than capacity loads) and the mooring stability of the ELCAS (NL) when the LSV or LCU-2000 were alongside. Since the ELCAS (NL) is 50-year-old technology and not designed to accommodate these large Army lighters, full interoperability is difficult to achieve. The Navy's recently delivered ELCAS (M) is to be tested with the LSV and LCU-2000.

- Another reported deficiency with the ELCAS (NL) is the time needed to offload, assemble, and install the complete elevated causeway. The JTD recommended that the planning factor for this operation be changed from 7 to 30 days. Since the operational window for employing the ELCAS is likely to be narrow, 30 days is too long for the system to effectively support early CINC requirements. A manufacturer-conducted test at Little Creek, Va., in April 1995 indicates that the ELCAS (M) can likely be offloaded, assembled, and installed in the 7-day standard established by the Navy.

- Ship RO/RO ramps must be certified for instream JLOTS discharge. RO/RO ships have either side or stern ramps [the large, medium-speed, RO/RO (LMSR) ship will have both] that when extended form a vehicle bridge between the ship and pier. In JLOTS operations, however, the ramp will rest on the RRDF, which will move as it is subjected to wave action. Ship ramps must be capable of withstanding this additional stress while vehicles are being driven off the ship. Since instream RO/RO operations are the most effective means for delivering combat vehicles ashore, the JTD recommended all RO/RO ship ramps be certified to perform that function.

The framework for correcting the deficiencies noted in JLOTS tests is in place. The JLOTS JIO is at the forefront in coordinating issues addressing interoperability. USTRANSCOM has also taken the lead to incorporate JLOTS in JCS-sponsored exercises. The Services routinely exchange information on research and development initiatives and emerging technology.

RDT&E and Emerging Technology

Both the Army and Navy are seeking technology solutions to improve their JLOTS capability. The Services are pooling engineering support through the Naval Surface Warfare Center, Carderock Division (NSWCCD). It has successfully tested the ACVLAP using an LCAC loaded with an M1A1 Tank. We estimate the cost of one ACVLAP to be approximately $4.5 million, or equal to the cost of one Army modular causeway system RRDF.

Navy Advanced Modular Causeway Lighterage System

The Navy is pursuing an advanced technology demonstration for a third-generation floating causeway system that can operate in SS3: the proposed Navy Advanced Modular Causeway Lighterage System. The first-generation causeway is the current Navy system, while the Army's modular systems now being procured are second-generation causeways. What is encouraging about the Navy's advanced modular causeway effort is that if the advanced technology demonstration is successful, causeway ferry payload capacity will increase by as much as 200 to 300 percent. Equally important, using an RRDF, ACVLAP, or floating pier constructed from this new system would enable the LSV, LCU-2000, and the LCAC to also operate at SS3 in a JLOTS role. If the Navy modular system operates satisfactorily in SS3, it will become the ship or shore interface for all other lighters that possess the same capability today but cannot work in SS3 because of seaworthiness limitations in current causeway systems. The Navy plans to fund $10.1 million for concept and advanced development of this system through FY99.

Army Upgrades

The Army is currently upgrading existing modular causeways and other lighters and improving interoperability between them. Among the upgrades is the development of a full-scale prototype to improve performance and capability of the LARC-LX, the Army's only amphibious lighter. One of the features of this prototype is an onboard roller system that can be used to unload containers onto the beach without container-handling equipment. The Army is also investing in a concept to develop a containerized maintenance facility for watercraft. The concept calls for a facility that can be modularized, is easily transported, and can be rapidly installed anywhere Army watercraft are employed. The Army has programmed $3.6 million for these initiatives.

The Advanced Research Projects Agency (ARPA) has taken the lead in assessing the Landing Ship Quay/Causeway (LSQ/C) and the robotic spreader bar with six degrees of freedom. These systems, if proven successful, will operate in SS3 and significantly improve throughput. The LSQ/C offers one potential option to significantly reduce the shortfall in meeting the large CINC 5 JLOTS container and breakbulk throughput requirements. ARPA selected the NSWCCD to manage these programs.

Landing Ship Quay/Causeway

The LSQ/C is a mobile causeway and pier head designed to transfer large volumes of material, trucks, artillery, tanks, containers, and petroleum, oil, and lubricants (POL) over a beach or shoreline. The deployed LSQ/C system can berth and discharge two oceangoing vessels in a manner identical to a permanently installed pier. Its concept calls for a modified, very large crude carrier (VLCC) to transport all mechanical equipment and prefabricated components required to assemble and deploy a 30-foot-wide elevated causeway to the shore. Brown and Root, the developer of this concept, estimates the VLCC size at 270,000 deadweight tons, 1,118 feet long, 178 feet wide, and 88 feet deep from the weather deck to the keel. The VLCC would be positioned at the operational site and "ballasted" down to stabilize it on the bottom in a water depth of 40 to 50 feet. Successful ballasting requires a sandy or mud bottom and a seabed gradient less than 1:50. Installation (primarily VLCC grounding) sea state would have to be demonstrated in testing, but based on experience with semisubmersible vessels, it will probably need to be close to SS0, or near calm waters. After grounding, the VLCC serves as a stable platform from which to begin installation of the causeway to the shore. Stacked on the VLCC deck are 150-foot-long causeway sections (67) sufficient to build up to 10,000 feet of causeway. These causeway sections contain semiautomatic deployable, adjustable, support columns to accommodate varying water depths and spread footings to provide load-carrying capacity from the sea floor to the causeway via the support columns. On-board cranes are used to install the causeway. The LSQ/C causeway would be 20 feet above the water and the surf zone, thus operating in sea states considerably higher than existing watercraft. A "liquid" mono-buoy is deployed adjacent to the VLCC and is used to pump fuel directly from the tanker to the beach.

Analysis of the ability to combine two LMSR's and their associated stern and side ramps with the LSQ/C is continuing. The size of the LMSR side and stern ramps and their deck footprints raises concern about traffic flow and productivity of the LSQ/C. Another area of concern is the ability to mate the ramps in higher sea states. Initial indications are that the LSQ/C will be limited to operations in SS3 and below. Model testing is required to determine whether cargo can indeed be transferred from ships to the LSQ/C in sea conditions worse than SS2 or SS3.

The joint LMI and ARPA estimate of the LSQ/C procurement cost (used tanker conversion) based on experience with past projects is $347 million. The procurement and modification cost of the VLCC can be generally compared to the current LMSR conversion cost of $212 million (less the LSQ/C causeway sections). We also estimate the cost to build a ship from the keel up to be about $444 million. The Brown and Root estimate for the LSQ/C with 2,550 feet of causeway is $104 million. (The LMI costs include the extrapolated cost of 10,000 feet of causeway, and the Brown and Root estimate was for 2,550 feet only.)

Advanced Crane Technology

ARPA and NSWCCD are also investigating advanced crane technology employing robotics and a six degree of freedom spreader bar that would enable cranes on T-ACS ships to handle containers in SS3. The robotic aspect, likely employing laser technology, will allow the crane to mirror the movement of lighters alongside the T-ACS. The spreader bar will compensate for the severe pendulous motion that occurs with cranes as ships move in heavy swells or seas.

Future Technology

The following future technologies are among those that industry considers as having potential JLOTS application:

- *Air Cushioned Bridging (ACB) System.* The ACB system is a lightweight, rapidly deployable causeway system employing an air supply valving and manifold concept. With the ACB, the air supply valves open before a load is moved along causeway sections and close after it has passed. This concept uses an innovative deployment scheme that extends an ACB unit by pressurizing the manifold tubes.

- *Ship "Outrigger" Transfer System.* The ship outrigger transfer system is a fold-down platform that functions as a pier and is secured to the side of a vessel. Air cushioned craft would be able to fly on and off the platform and be loaded with cargo that is moved to the platform through an opening in the side of the ship or lowered from topside with the ship's crane. The platform is attached to the hull near the water line by a hinge mechanism that allows the outrigger system to pivot and thus heave as a function of sea state and platform loads.

- *Heavy-Lift Air Taxi (H-LAT).* The H-LAT is based on a powered, modified, harnessed parafoil (a kite and sport parachute with gliding and steering characteristics). This concept is not affected by surface obstacles and is able to move a payload inland for up to 500 miles at a speed of approximately 100 mph. The H-LAT is launched from ships that have a flight deck or a floating pontoon (causeway) landing platform.

- *Very-High-Speed Ferry Vessel.* This vessel has a shallow draft and is capable of operating at 60 to 80 knots employing a four-hull (quadrimaran) design with low freeboard beaching capability. A number of different design concepts call for this craft to be built in passenger and RO/RO configurations.

Of these technologies, DoD is currently assessing the feasibility of high-speed vessels.

Deployability

A number of options are available for positioning JLOTS forces to support unified command requirements. In many instances, positioning will first be a time-and-distance equation and then a determination of how best to move assets. In other cases, however, the JLOTS operation may begin too early and be too large to be satisfied by either afloat prepositioned or CONUS-deployed forces. Table 2-4 shows the need for employing all available means to position craft to meet CINC requirements. From the table, we see that four of the five unified commands have JLOTS forces in their theater area of operations prior to C day. Nevertheless, since operations begin between C007 and C021, only one unified command has sufficient lighters available from "theater" assets to accomplish the mission. For two of the five unified commands, the throughput shortfall is not overcome with the arrival of the first deployed lighters. JLOTS forces also must be positioned early for three of the five unified commands. Here we define early positioning as the time (in some cases before C Day) needed to identify and move lighters to the JLOTS site to begin operations in accordance with the CINC plan. For two unified commands, CINCs 4 and 5, some combination of alternatives that include early positioning and forward-deploying or forward-stationing may be appropriate.

Table 2-4 .
Early Deployment and Positioning

CINC	LOTS forces in theater prior to C day	JLOTS begins	In theater forces meet most demanding daily throughput requirement	First arriving deployed capability	Meets most demanding daily throughput requirement	Early positioning of JLOTS forces
CINC 1	Army	C011	No Approximately 5,400 ton daily shortfall	C010 MPS and Army self-deploying lighters	Yes	
CINC 2	Army Navy	C011	Yes			
CINC 3	None	C021		AWR-3 and Army self-deploying lighters	Yes	The early positioning of Army lighters is required to commence operations at C021.
CINC 4	MPS AWR-3	C011	No Approximately 2,000 ton daily shortfall in Phase I.	C012 - MPSRON C015 - AWR-3 C021 - 2 MPSRON C022 - ACU C027 Army self-deploying craft	Yes	C Day for commencing Phase II not established. The early positioning of Army lighters is required to eliminate Phase I shortfall and if Phase II commences before C040.
CINC 5	MPS AWR-3	C007	No Approximately 19,000 ton daily shortfall in Phase I	C011 MPSRON C012 AWR-3 C018 MPSRON	No Approximately 12,500 ton daily shortfall in Phase II	LSVs and LCU-2000s must be positioned to commence operations at C007. Additional FLO/FLO ships chartered to position Army lighters in AOR for Phase II.

Note: AWR = Army War Reserve, MPS = Maritime Prepositioned Squadron, ACU = Assault Craft Unit

Now that the unified commands have made an initial determination of their JLOTS requirements, the logical next step (after refinement of the original determination) is to identify the forces needed to execute their JLOTS missions using the deliberate planning process. Deliberate planning, creation of JLOTS time-phased force deployment packages, and procedures for early positioning of watercraft with or without strategic sealift are all necessary steps in creating the JLOTS force that will execute CINC JLOTS missions.

Table 2-5 shows the options available for moving each of the lighters that may be employed in JLOTS operations. For instance, the Army LSV is self-deployed; the Army LCU-2000 can be either self-deployed or loaded aboard a FLO/FLO ship; Navy causeways can be deck-loaded on a number of different types of ships; and the Navy LCAC and LCU-1600 can move to the objective area either aboard a combatant ship, FLO/FLO ship, or barge ship.

Table 2-5.
Deployment Options

Lighter	Self-deploy	Amphibious ship	FLO/FLO or heavy lift ship	Barge ship	T-ACS	RO/RO ship	Container ship	Breakbulk ship
LSV	✓							
LCU-2000	✓		✓					
LCAC		✓	✓	✓				
LCU-1600		✓	✓	✓				
LCM-8			✓	✓	✓	✓	✓	✓
LARC-LX			✓	✓	✓	✓	✓	✓
Causeways (NL)				✓	✓	✓	✓	✓
MCS				✓	✓	✓	✓	✓

Note: This is a notional depiction based on likely alternatives. Lighters are not limited solely to transportation aboard the ships shown.

Again, an example for 1995: a CINC requires ten LCU-2000s to commence intracoastal or JLOTS operations at C011, and only two can currently be made available from the prepositioned FLO/FLO ship. To overcome the shortfall of eight LCU-2000s, either additional prepositioned FLO/FLO ships are needed to carry the lighters, the lighters are positioned early in the crisis action phase much like a flexible deterrent option, or the craft are forward-stationed, forward-deployed, or prepositioned within sailing distance of the designated JLOTS site. The optimum solution is likely to be a combination of these alternatives. Should a CINC rely solely on those lighters that are today available aboard the MPF and APF, it may require 30 to 45 days to self-deploy or transport all lighters deployed from CONUS. This could well have an adverse impact on the unified command campaign plan.

Chapter 3

Assessment Results

In evaluating unified command JLOTS requirements and the collective capability of the Services to meet those requirements, we identified a number of factors that will influence the level of JLOTS support provided to a unified commander. The results of our modeling, coupled with the importance of these contributing factors, form the basis for the findings, conclusions, and recommendations of this assessment.

FINDINGS

In performing our evaluation, we found the following:

- The JLOTS requirements of four of the five regional CINCs could reasonably be met under the assumptions on which we based our analysis. Those assumptions entailed the number and type of craft available in each region, the early integration of component JLOTS forces, the early positioning of some Army craft, the sea state conditions, and the cargo mix. Four of the five regional commands have established a JLOTS requirement varying between 6,000 and 8,000 short tons per day. The fifth unified command (CINC 5) requires almost four times that daily throughput. Although indications are that requirements for CINC 5 may be reduced on the basis of changes in the planning assumptions, an essential element in the deliberate planning process for CINC 5 and each of the other CINCs is the refinement of their JLOTS requirements.

- Unified command JLOTS requirements varied between the need to move 25,000 and more than a million short tons of equipment and supplies. Because of the wide variance in those JLOTS throughput requirements and the different operating environment for each regional CINC, JLOTS forces must be tailored to meet specific missions. This assessment was able to draw on the strengths of the Army and Navy LOTS programs. For the Army, LSVs and LCU-2000 are sound investments. Both are exceptionally capable multimission craft. The Navy, on the other hand, has focused on floating and elevated causeway systems. New causeway systems that are being delivered or considered for development are well suited for handling all MPF and AFOE equipment and supplies, particularly containers and breakbulk cargo. The Navy is also moving to integrate its capable LCAC from the ATF into its LOTS operations. Tailoring the JLOTS force by selecting a mix of lighters best suited to perform the mission is essential. We found that the most efficient JLOTS operation is one that uses Navy causeways and the Army's LSV and LCU-2000, particularly when a large number of tracked and wheeled vehicles must be moved, as with the interim Army Heavy Brigade Afloat.

- Overcoming adverse sea state conditions with current JLOTS equipment requires thorough consideration be given to the consequences of reduced throughput as sea state increases. Maximizing the capability of ship-to-lighter and lighter-to-shore interface systems while capitalizing on the efficiencies of modern container and RO/RO ships will require extensive use of T-ACS ships and RRDFs to deploy containers and tracked and wheeled vehicles. The capability to operate three to four cranes to unload a containership and the 100 percent increase in throughput realized when mooring an RRDF to a RO/RO ship attest to the advantages of employing an integrated system of systems approach to JLOTS operations. The effects of sea conditions can be mitigated by selecting sites close inshore and in protected harbors or anchorages and maximizing throughput when seas are calm. Promising technology with the potential for operations in SS3, particularly the Navy's proposed Advanced Modular Causeway Lighterage System, can have a significant effect. If that system were available in addition to the LSV and LCU-2000 (and the LCAC when an ACVLAP is developed), which are currently capable of operating in SS3, the JLOTS community would have a ferry, an RRDF and a floating pier with the same SS3 capability – a true example of a system of systems approach in technology in which each system is an enabler of the next.

- The force structure needed to support both fixed port and JLOTS operations is heavily weighted to the Army and Navy Reserve. From lighter crews to cargo-handling units, a significant portion of the force structure needed to receive the early arriving force in a single MRC comes from the Reserve Components.

CONCLUSIONS

On the basis of our findings and analysis, we draw the following conclusions:

- The single most important conclusion from this evaluation is the need to train the JLOTS force in a joint environment. While much has been done to designate candidate JCS-sponsored exercises for bringing together a joint team in a realistic unified command setting, continued support by the unified commands and the Services is essential to fully implement a JLOTS training program. Training the JLOTS force or bringing together Army and Navy units for joint training and exercises will improve JLOTS productivity. When we selected planning factors from JLOTS II and III test data, both the Army and Navy indicated improvements could be made. Our discussions with vessel masters and operations personnel reveal that cargo handling and lighter operations significantly improve after frequent and rigorous JLOTS training. In our research to establish planning factors for the JOTE model, only JLOTS II and III tests provided complete cycle times, but because of the wide variance in some data, we believe training is the key component in maximizing productivity to overcome limitations in currently fielded JLOTS equipment.

- Now that they have identified a JLOTS requirement, CINCs and their Component commanders can focus on regional JLOTS training opportunities in JCS-sponsored exercises.

- Positioning the JLOTS force to conduct operations most effectively requires exploration of a number of alternatives to afloat prepositioning. An important consideration for coordinating the integration of Service LOTS forces to perform JLOTS is the early date in the deployment phase that they are needed to support a unified command. In all but one instance, the unified command required a substantial joint capability with the arrival of the MPF or APF material and the early deploying combat forces. While Navy causeway lighters can be deployed aboard MPF and commercial shipping, the means for delivering the larger LSVs and LCUs is limited. Those lighters are needed in large numbers to support all unified commands, but in the case of CINCs 4 and 5, neither can be made available in time or in sufficient numbers when self-deployed or loaded aboard the single leased FLO/FLO ship currently available. Some of the alternatives to afloat prepositioning are early movement of the lighters, purchase of additional FLO/FLO ships, a program for area specific prepositioning, and forward-stationing or forward-deploying these boats.

- The Army and Navy are in a position to effectively coordinate their efforts to meet CINC JLOTS requirements. Our assessment underscores the need for early Service and CINC planning decisions in order to ensure that the most capable and interoperable JLOTS force is emplaced as soon as possible to support unified command operations. In making these planning decisions, the Services and unified commands would coordinate on deployment, stationing, and force structuring options.

- The TRANSCOM role and those of the Services and CINCs in meeting CINC JLOTS requirements are to develop theater opening support packages and establish procedures for the rapid lift of JLOTS watercraft and forces.

- The Regional Unified Commands, having identified their JLOTS requirements, can begin detailed coordination with their Component commands and TRANSCOM to develop JLOTS force packages in operations plan (OPLAN) and concept plan (CONPLAN) time-phased force deployment data (TPFDD).

- The evaluation also highlighted the need for JLOTS systems that can operate in SS3. Having a system or system of systems that can operate in SS3 or higher conditions (where today JLOTS is effectively halted), will significantly enhance productivity and cargo throughput capability.

We conclude that the following Service programs offer the greatest potential for enhancing JLOTS operations:

- The Army can leverage productivity of the LSV and LCU-2000 by accelerating the lease of a second FLO/FLO ship and focusing modular causeway system procurement on RRDFs and piers.

- The Navy is correctly strengthening its LOTS capability and overall contribution to JLOTS by focusing on testing and evaluating the ELCAS (M) and obtaining an air cushioned vehicle landing platform enabling the LCAC to operate in a LOTS and JLOTS environment.

- The Navy and ARPA are positioned to proceed with technology demonstrations on the Advanced Modular Causeway Lighterage System, LSQ/C, and robotic crane. If the demonstrations prove successful, and the challenge in meeting unified command requirements remains significant, Service programs can be modified to develop accelerated acquisition programs for these systems. These emerging programs have the potential for offering a longer term solution for breaching the SS3 barrier through a system of systems approach in leveraging advanced technology:

    - The LSQ/C to meet CINC 5 warfighting support requirements that cannot be met as these requirements are articulated today.

    - The Advanced Modular Causeway Lighterage System that will enable operations in all unified command areas of responsibility to continue in SS3 and enhance the SS3 capability of larger JLOTS systems (LCAC, LSV and LCU-2000).

    - The robotic crane fitted to T-ACS to afford greater flexibility for continuing container discharge as sea state conditions worsen.

- Modeling conclusions indicate that, in the near term, both the Army and Navy need to assess their force structure capability to concurrently support fixed port and JLOTS operations. This will include an evaluation of the Active and Reserve Component force ratio to determine if the Active Component is sufficiently resourced to accomplish the unified command early entry force reception and onward movement mission. Given a better definition of JLOTS requirements, the Army is also now in a position to determine the need for forward stationing/prepositioning craft to support the unified commands.

Recommendations

Our assessment provides the following 11 recommendations to enhance JLOTS operating capability – one primary and ten others:

- First and most important is training of the JLOTS force. The Joint Staff should seek every opportunity to integrate JLOTS forces into JCS-sponsored exercises. Where JLOTS is a key element in a unified command CONPLAN or OPLAN, frequent training will hone critical perishable skills of the joint team.

Further, the Director for Logistics, The Joint Staff, should recommend the following actions:

1. That the Army accelerate the leasing process to obtain a second FLO/FLO ship to carry lighters, harbor craft, and floating craft for the Army Theater Opening Force Modules. These watercraft packages are designed to support operations ranging from humanitarian relief to a major regional contingency. TRANSCOM should consider in-place lease agreements to obtain two additional FLO/FLO ships during crises.

2. That the Army assess the need to forward-station heavy boat assets in areas in which their early demand cannot now be met through self-deployment or strategic sealift assets.

3. That USTRANSCOM, Regional Unified Commands, and the Services develop coordinated fixed port and JLOTS support packages to meet CINC CONPLAN and OPLAN requirements.

4. That USTRANSCOM, Regional Unified Commands, and the Services develop procedures for the early lift (strategic sealift and movement to the objective area) of watercraft and JLOTS force packages (crews, cargo handlers, and maintainers).

5. That the Regional Unified Commands identify the requirement for JLOTS forces in TPFDD developed in conjunction with deliberate planning processes. Development of such data includes identifying a requirement for strategic sealift to move the JLOTS forces packages (craft, personnel, and equipment).

6. That the Army and Navy assess the adequacy of their LOTS and fixed port force structures in meeting unified command requirements. That assessment should include a determination of the effectiveness of the current ratio of Active and Reserve Component forces.

7. That the Army focus its second-generation modular causeway procurement effort on the RRDF and floating causeway pier as enhancers for the current fleet of LSVs and landing craft.

8. That the Navy obtain the ACVLAP to provide the LCAC with a fly-on/fly-off platform that will enable that craft to operate in a JLOTS environment.

9. That the Navy use its operational evaluation program to determine the ability of the ELCAS (M) to meet unified command requirements.

10. That the Navy and ARPA aggressively pursue RDT&E for the LSQ/C, the Advanced Modular Causeway Lighterage System, and the robotic crane technology for auxiliary crane ships.

Appendix A

Study Plan

Study Plan

Objective

This is an initial assessment of Joint Logistics Over the Shore (JLOTS) requirements and capabilities performed for the purpose of Joint Staff briefing the Joint Requirements Oversight Council (JROC). A subsequent, in-depth study is planned that will analyze the Services' JLOTS capability to support two near simultaneous Major Regional Contingency deployments as determined by the Mobility Requirements Study-Bottom Up Review Update.

The objective of this initial assessment is to evaluate the future direction of the DoD logistics over the shore (LOTS) program. The outcome will result in findings and recommendations presented to the JROC in January 1995 and will specifically focus on the continuation of current and emerging Army and Navy JLOTS programs and the development of future programs based on other technologies.

Problem Definition

The DoD requirement for a JLOTS capability has not been clearly defined in the post-Cold War environment. The need for retaining this force projection logistics capability into the 21st Century has been questioned on the basis of cost and operating limitations demonstrated in the combined fleet of Army and Navy watercraft. While regional Commander in Chief (CINC) requirements for JLOTS capable forces continue to be refined, programmed improvements in over the shore delivery platforms through modification of existing craft and acquisition of modular floating causeway systems provide no added capability for operations in Sea State 3 (Joint Pub 4-01.6 - moderate sea with large wavelets having a significant wave height of 3.5 to 5 feet, breaking crests and winds of 13.6 to 16.3 knots) or higher. Two options are presented in employing JLOTS capable forces. One is to operate in fixed ports where accessibility is restricted or denied to large strategic sealift ships; the other, being to land equipment and supplies on or over a bare beach. In the former, site selection is predicated on calm anchorage or harbors allowing craft to continuously operate as an extension of the fixed pier regardless of sea state conditions beyond the breakwater. In the latter, sea state from the open ocean will restrict and delay operations depending on location and season of the year. While two employment options are available, only the over the shore capability will be assessed to measure capabilities of the programmed fleet against those of emerging or future systems, unless a CINC has identified JLOTS port enhancement packages in support of an Operations Plan (OPLAN).

In postulating the need for this over the shore capability, the issue is raised of the Army and Navy having a substantial investment in JLOTS capable forces that may be both redundant and lack interoperability. Although each Service has different missions for their organic craft, it has yet to be determined whether individually or collectively they are sufficient to meet evolving regional CINC requirements. Therefore, capability will be measured. It includes not only the amount of cargo the different craft can deliver, but also the adequacy of the cargo-handling unit force structure integral to JLOTS operations. An example is terminal service companies. The majority of these units are necessary whether a full fixed port or bare beach site is used in meeting CINC requirements. In this case, it is possible to plan for a combined fixed port and JLOTS operation that exceeds the available terminal service company force structure. We will also assess the options for deploying these JLOTS forces to fulfill CINC requirements.

SCOPE

The assessment will involve a review of past JLOTS analyses and other operational data to obtain source information and relevant findings in appraising the continued viability of current systems and the potential for emerging/future technologies to improve the delivery of cargo over the shore.

Using regional CINC requirements for dry cargo (e.g., tons, pieces, TEUs, UE, NUC, etc.) to be moved over the shore, the location of beach sites with pertinent descriptive operational data, and a sequencing in relation to C Day for each operation being conducted, we will identify the JLOTS capability necessary to support these missions. Standard JLOTS planning factors (as determined by JLOTS tests, Army and Navy operating experience, and the ongoing Logistics Management Institute (LMI) study of Army watercraft) will be applied to establish productivity for the various watercraft.

Because of the interrelationship of the many factors associated with this assessment, the following baseline data will be collected and arrayed:

- CINC JLOTS cargo requirements can generally be determined if cargo data is broken out by class of supply with the number of containers or short tons and the number of wheeled and tracked vehicles. Should the only data available be defined as dry and liquid cargo along with the measurement tons in each category [i.e. no time phased force deployment data (TPFDD)], we will attempt to further identify this cargo in consultation with the Project Monitor.

- CINC requirements for intracoastal or inland waterway cargo movements will be collected where available and considered separately for dual-mission watercraft [Army Logistics Support Vessel (LSV) and Landing Craft Utility (LCU)-2000].

- Similarly, Navy watercraft employed principally in support of amphibious assault operations will be identified as dual-mission craft.

- Along with JLOTS cargo requirements, we will obtain available JLOTS site data from regional CINC plans that includes location, gradient, sea bottom and beach composition, prevailing sea state, and throughput analysis when available. As it is generally agreed that operations in SS3 will not routinely be conducted, information on prevailing sea states will be used to establish watercraft requirements and operations tempo.

- From the Services, we will obtain force structure and watercraft inventory data on the current and programmed capability. CINC TPFDDs will be reviewed to ascertain what portion of this capability is earmarked to accomplish the JLOTS mission. Where a requirement exists, but a JLOTS capability has not been included in the TPFDD, composition of the JLOTS force will be determined by the amount of cargo to be moved, time frame in which it must be moved, and the site selected for beach operations.

- Two specific sets of watercraft prepositioned afloat will be the basis or building block for the capability assessment. They are the Army's Theater Opening Force Module A (TOFM A) with the Afloat Prepositioned Force and Navy floating craft with the Maritime Prepositioned Force (and where appropriate, watercraft from deployed Amphibious Ready Groups). Since a number of the craft in the TOFM package do not have a cargo movement mission and are needed whether in a fixed port or JLOTS operation, they will be treated separately in an annex. All other Army and Navy watercraft (LSV; Landing Craft, Air Cushionred (LCAC), LCU-2000; LCU-1600; Landing Craft, Mechanism (LCM)-8; LARC-LX; and causeway systems) that are not prepositioned will also be included in the capability assessment.

- We will seek information from U.S. Transportation Command (USTRANSCOM) on the availability of shipping to transport watercraft into the regional CINCs areas of responsibility, on when that shipping will be available, and on what craft can be transported. The ability to move watercraft will be weighed along with CINC JLOTS requirements and the time frame in which they are to be met.

- We will employ the LMI JLOTS simulation model to assess closure time in relation to cargo and equipment to be moved, available watercraft, and weather. It may be possible to then work this data back to Model for Intertheater Deployment by Air and Sea (MIDAS) for a strategic snapshot on the total effect of JLOTS on force closure.

Study Approach

The method by which this assessment will be conducted encompasses three parts. Part 1 involves acquiring data on the regional CINCs' requirement for moving cargo over the shore at selected beaches or in a restricted access port identified by CINC planners. Part 2 will involve the research of Army and Navy JLOTS missions, force structure, and watercraft inventories. Additionally, we will review the Services' programmed procurement of modular and elevated causeway systems and the Navy's research, development, test, and evaluation (RDT&E) program for the Amphibious Cargo Beaching Lighter. Part 3 will focus on emerging/future technologies that could improve or replace current and programmed JLOTS capability. During Part 3 findings on CINC requirements, current capabilities and emerging technologies will be weighed in providing LMI's best professional judgment on recommendations regarding the continued viability of the current JLOTS program and the development of future programs.

All data and modeling assumptions will be jointly developed with, and approved by the Project Monitor. While some portions of the assessment can be accomplished concurrently, this three part study generally requires a sequential approach. Interim progress reports, in progress reviews, and briefings will be integrated into a final complete package.

Part I

Cargo level detail data will be collected from USTRANSCOM and the regional CINCs on JLOTS requirements. Also to be collected is data on beach sites or ports to be enhanced that the respective CINCs have selected.

Part II

We will collect data on the Army and Navy LOTS missions, current and programmed force structure, watercraft inventories, RDT&E initiatives, employment doctrine, how the craft will be deployed to the objective area, and other information pertinent to the JLOTS assessment.

Part III

We will review emerging/future technologies for their potential to enhance JLOTS operations when weighed against current and programmed (modular causeway, elevated causeway, and Amphibious Cargo Beaching Lighter) JLOTS capabilities. Requirements, capabilities, and future technologies warranting further investigation will be assessed in providing operations-oriented findings, conclusions, and recommendations for JROC consideration. We will accomplish this by utilizing pertinent data and information from the strategic mobility technology assessments being conducted separately by LMI.

Limits and Uncertainties

If release authority limits LMI access to CINC JLOTS requirements or OPLANs, we will restrict our study to that data that can be made available by the Joint Staff.

Definitive data on CINC JLOTS requirements may not be available. In this case, coordination with the Project Monitor, USTRANSCOM, and the respective staffs of the regional CINCs will be made to obtain the planning factors necessary for conducting the assessment.

It is assumed that the Services will be fully responsive in providing necessary data and information on JLOTS programs and plans. We will accept as fact Service-provided data on present and programmed force structure and watercraft inventories.

Products

- Meetings, as mutually agreed upon, with the Project Monitor to gain and exchange information or data on study elements and resolve issues as they arise.
- A bi-weekly progress briefing to provide the Project Monitor the status of the assessment.
- A draft package of final charts and information papers with findings, conclusions, and recommendations to the sponsor by 1 December 1995.
- A final package of charts and information papers with findings, conclusions, and recommendations provided to the sponsor by 15 December 1995 for presentation to the JROC. A final written compendium of the results by 28 February 1996.

Appendix B

The Estimator Model and Modeling Assumptions

The Estimator Model and Modeling Assumptions

Historical Perspective

We developed the Joint Over the Shore Transportation Estimator (JOTE) model at the Logistics Management Institute (LMI) to better model instream discharge operations from large, ocean-going vessels into lighters that ferry materiel to shore. JOTE was first developed for use in an Army study of Logistics Over the Shore (LOTS). The study of the Joint LOTS (JLOTS) is not new, but the current emphasis on the topic is.

During the Cold War era, the only identified requirement for JLOTS was in the Persian Gulf and Korean Peninsula areas. The Military Services acquired a capability to meet this requirement. After the Iran and Iraq conflicts ended, the strategic vision shifted away from limited ports and onto areas of operation where there were deep draft ports readily available. The advent of many operations other than war (OOTW) and the real possibility of entering an area without a well-defined infrastructure has again shifted the DoD logistics community into examining the plausibility of conducting JLOTS operations to deliver the combat force ashore and sustain it where fixed facilities are unavailable or inadequate.

The issue is more than just applying existing assets to arising problems. Questions about the adequacy of current lighter assets and future procurements surround JLOTS operations. To sufficiently analyze these concerns, new, more powerful modeling tools were required.

Model Overview

The JOTE uses cargo lane assignments, operational readiness, lighter mix available, and sea state information to optimally assign watercraft trips per lane at the JLOTS site. The model minimizes the overall shortfall in cargo throughput as measured in short tons.

The JOTE is written in Visual Basic and uses the math programming optimization routine imbedded in Excel 5.0 to determine the solution set. The model runs on any personal computer (PC) capable of supporting Excel 5.0.

The model is configured to simultaneously optimize lighter assignments on up to 24 lanes. JOTE allows selection from 9 lighter types including the Landing Craft, Mechanized (LCM)-8; Landing Craft, Utility (LCU)-1600; LCU-2000; Logistics Support Vessel; Causeway System, Powered (CSP)+3; CSP+2; CSP+1; Heavy Lift Landing Craft, Air Cushioned (HLLCAC); and Landing Craft, Air

Cushioned (LCAC). The lanes can be assigned to one of four types of discharge: roll-on/roll-off (RO/RO) wheel, RO/RO track, lift-on/roll-off (LO/RO) wheel, and lift-on/lift-off (LO/LO) operations.

Model Inputs

The two types of model inputs are those specified at run time and those imbedded in JOTE's integral spreadsheet. The parameters imbedded in the spreadsheet include

- the average travel time for a lighter to make a round trip to a ship one nautical mile from shore and back (JOTE can accommodate distances up to 50 nautical miles);
- the average amount of time (by discharge lane) it takes a lighter to
  - approach and moor at the ship,
  - load,
  - castoff and clear the ship,
  - approach and moor at the beach or pier,
  - unload at the beach or pier, and
  - castoff and clear the beach or pier;
- the average load each lighter can carry, by discharge lane;
- the average fraction of time the sea state is 3 and above; and
- the operational readiness of the lighter fleet.

LMI gathered this information from a variety of sources including operations "after action" reports from JLOTS II and III, Joint planning factors, manufacturers' reports, and Marine Corps studies.

The inputs imbedded in the spreadsheet can be changed by a knowledgeable user. For example, during our subsequent analysis of the HLLCAC, we tried various configurations of speed and cargo-carrying capability with the HLLCAC to see where its best performance lay on the weight/speed curve.[1] The cells for operational readiness rate for the lighter fleet and the percentage of time the sea state is above 2 (i.e., SS2) are displayed with the output for the model; they are readily accessible.

[1] LMI Report JS502MR2, *Assessment of the Heavy Lift Landing Craft, Air Cushioned, JS502MR2*, Peter J. Thede, et. al., August 1995.

The run time parameters for JOTE include

- the distance from the ship to the shore,
- the lighter fleet available by type of lighter,
- the number of discharge lanes in the operation,
- the type of discharge being accomplished on each lane, and
- the tonnage to be moved on each lane.

The user can easily modify these parameters and run the model again to see the impacts of changing assumptions. For example, if the weather is much worse than anticipated, it may require the commander to staff more lanes or increase the number of lighters available for JLOTS operations. A sudden change in the type of cargo may require that lighters be reassigned to different lanes.

The JOTE allows the user to specify changes in the lane type and tonnage assignments from day to day. So, if an RO/RO track lane is completely discharged, the model allows the user to specify that he/she is using the recently vacated RO/RO track lanes for RO/RO wheel discharge, etc.

Model Outputs

JOTE displays the trips required by day by lighter type in each lane to achieve the optimal throughput capability, subject to operational readiness, lane, lighter, and tonnage constraints. In Table B-1, we see the model has assigned one LSV run for the day to each of the Lanes 1, 2, 3, and 4; JOTE has assigned four LCU-2000 runs to Lanes 6, 7, and 9. No assignment has been made for the other craft. (Note that it could be the same LSV or several making these runs.)

In Table B-2, we see that JOTE displays the type of lane and the short tons remaining after the projected movements for the day. JOTE displays the same results for the case when sea state conditions are factored into a site's production. For example, Lane 1 is a RO/RO track lane. There were 306 short tons moved on Lane 1 that day, which left 19 hours under ideal conditions. However, once the sea state conditions were taken into account, the number of slack hours on that lane dropped to seven.

Table B-1.
Output from JOTE (Lane Assignments)

Lane	LCM-8	LCU-1600	LCU-2000	LSV
1	0	0	0	1
2	0	0	0	1
3	0	0	0	1
4	0	0	0	1
5	0	0	0	0
6	0	0	4	0
7	0	0	4	0
8	0	0	0	0
9	0	0	4	0
10	0	0	0	0

Table B-2.
Output from JOTE (Sea State)

Lane	Short tons moved	Short tons left	Discharge type	Hours left	Hours left with SS	Short tons shortfall with SS
1	306	0	RRDF track	19	7	0
2	416	0	RRDF vehicle	16	4	0
3	416	0	RRDF vehicle	16	4	0

JOTE also displays the usage by lighter type. In Table B-3 we see that there were 18 LCU-2000s available for use in the JLOTS operation. Of these, 3 were used by the model on the lanes assigned that day. This leaves a surplus capability of 15 craft. However, given the operational readiness rating, this leaves only 12 LCU-2000s which can be assigned to other sites or missions.

Table B-3.
Output from JOTE (Lighter Availability)

	LCM-8	LCU-1600	LCU-2000
Available	8	3	18
Used	0	0	3
Remaining	8	3	15
Remaining given OR	7	3	12

Model Description

JOTE uses math programming techniques to arrive at the optimal assignment of lighters to lanes. This section describes that math program in detail.

Throughout this section, we use i to index the lighter type (e.g., LSV and LCU-1600), j to index the lane, and k to specify the type of cargo discharge taking place. The decision variable for JOTE is the trips by lighter type by lane; we call this T_{ij}. For example, T_{23} would refer to the number of lighter trips made by lighter type 2 in Lane 3. The variable P_{ik} is the average productivity for lighter type i when carrying cargo type k. We denote the amount of cargo to be carried in each row as C_j. We define the boolean variable D_{jk}, which is defined as

$$D_{jk} = \left\{ \begin{array}{c} 1 \text{ if Lane } \mathbf{j} \text{ is assigned to carry cargo type } \mathbf{k} \\ 0 \text{ else} \ldots \end{array} \right\}.$$

We can then describe the tonnage moved across lane j as

$$\sum_i \sum_k D_{jk} P_{ik} T_{ij}$$

Further, we can describe the shortfall as

$$C_j - \sum_i \sum_k D_{jk} P_{ik} T_{ij}$$

Our objective in JOTE is

$$\text{Minimize} \sum_j (C_j - \sum_i \sum_k D_{jk} P_{ik} T_{ij}).$$

Some constraints need to be followed. For example, each lighter cannot be worked more than 20 hours per day. We will call the maximum number of lighters available for type i lighter to be M_j. Another factor in lighter availability is the operational readiness rate of the lighters. For example, if you have 20 lighters, but the lighters are broken down 50 percent of the time, then you really only have 10 lighters, on average, available to work for you. We call the operational readiness rate for lighter type i to be R_i. Lighters are required both at the ship and the shore. For safety reasons, a lighter must be allowed to castoff and clear before another lighter can approach and moor. Naturally, the lighter must load and unload. All these things take time. We refer to the total of this time as A_{ik} for lighter type i carrying cargo type k. Likewise, we call the maximum time either on shore or at the ship for these administrative procedures A'_{ik}. The distance from the ship to the shore in nautical miles is L, and the amount of time it takes for lighter type i to make a round trip at one nautical mile is G_i. Now, we can describe the constraint on each type of lighter as being

$$\forall i \sum_j \left[(T_{ij}(LG_i + \sum_k D_{jk} A_{ik}) \right] \leq 0.84\ R_i\ M_i.$$

The constraints for the individual lanes are calculated using a similar procedure. If we call S the fraction of time that the sea state is 3 or above (currently, JLOTS transload operations cease during these conditions), then the constraint on the lanes is

$$\forall j \sum_i \sum_k D_{jk} A'_{ik} T_{ij} \leq 0.84\ S.$$

It would be desirable for the model to only assign enough lighter on a lane to carry the cargo required there. Then we have a production constraint of

$$\forall j \sum_i \sum_k D_{jk} P_{ik} T_{ij} \leq C_j.$$

Also, we want our decision variables to be integral and nonnegative, which leads to the constraints

$$\forall i, j\ T_{ij} \geq 0, T_{ij} \in Z.$$

In total, the math program for JOTE can be described as

$$\text{Minimize} \sum_j (C_j - \sum_i \sum_k D_{jk} P_{ik} T_{ij}),$$

subject to

$$\begin{gathered}
\forall i \sum_j (T_{ij}(LG_i + \sum_k D_{jk} A_{ik})) \leq 0.84\ R_i M_i \\
\forall j \sum_i \sum_k D_{jk} A'_{ik} T_{ij} \leq 0.84\ S \\
\forall j \sum_i \sum_k D_{jk} P_{ik} T_{ij} \leq C_j \\
\forall i, j \geq 0, T_{ij} \in Z.
\end{gathered}$$

Modeling Assumptions

In our evaluation of the future direction of the DoD JLOTS program, we made several scenario-based operational assumptions, which with the JOTE model provide the data upon which our analysis is founded. The assumptions include the existence of a uniform requirement and capability measurement methodology, the coordination and integration of Service LOTS capability, the capability of some craft to self-deploy to an objective area, and the early positioning of JLOTS assets to meet unified command requirements. From these assumptions, a uniform methodology is available for examining each requirement. Modeling assumptions are specific to the scenarios and requirements of each unified command. In the analyses presented in Chapter 2 of the main text, we refer to the unified commands as CINC 1 through CINC 5 to keep the evaluation unclassified. The assumptions are described in detail in the following subsections.

Uniform Requirement and Capability Measurement Methodology

A uniform requirement and capability measurement methodology was developed to model the five Regional Unified Command JLOTS requirements.[2] With the exception of those of USACOM and USSOUTHCOM, JLOTS requirements were largely provided in measurement tons of general cargo or containerized cargo and ammunition to be moved [USACOM and USSOUTHCOM were able to provide more specific information on units and classes of supply – Class I (subsistence) through Class IX (repair parts)]. However, since 1 measurement ton is equal to 40 cubic feet (a unit of measure more appropriate to ocean-going vessels), we needed a yardstick for lighters and our JOTE model. To determine the ratio of equipment to supplies, we first converted measurement tons to short tons and then used the Army interim Heavy Brigade Afloat ratio of tracked and wheeled vehicles and containerized unit equipment to establish a more detailed breakout of cargo translatable to JOTE. While we acknowledge that in all JLOTS operations the Army interim Heavy Brigade Afloat ratio of vehicles and containerized unit equipment may not be the case, we used that mix of cargo as a notional measurement to establish a baseline for the assessment. Refinement of CINC JLOTS requirements will necessitate adjustments based on actual cargo information.

The following factors establish a uniform requirement and capability measurement:

- *Converting measurement tons to short tons.* In those instances in which CINC planners provided JLOTS requirements using measurement tons, the following conversions apply [consistent with U.S. Transportation Command's (USTRANSCOM's) earlier work]:
  - Breakbulk and containerized ammunition – 1.06 short tons (S/T) per measurement ton (MT)
  - Breakbulk and containerized cargo – 2.42 S/T per MT.

[2] The five Regional Unified Commands are the U.S. Atlantic Command (USACOM), U.S. Central Command (USCENTCOM), U.S. European Command (USEUCOM), U.S. Pacific Command (USPACOM), and U. S. Southern Command (USSOUTHCOM).

- *Defining the JOTE cargo mix.* The Army interim Heavy Brigade Afloat is used in determining the mix of tracked and wheeled vehicles and accompanying containerized unit equipment:

  - 23 percent of total S/T is tracked vehicles – average weight 31 S/T.

  - 68 percent is wheeled vehicles – average weight for vehicles is 13 S/T and trailers 15 S/T; for wheeled vehicles an average weight of 14 S/T applies.

  - 9 percent of total weight is containerized unit equipment.

- *Containerized cargo.* Weights of containerized unit equipment, general supplies, and ammunition vary by commodity. The following Military Traffic Management Command (MTMC) conversion factors apply:

  - Unit equipment – 6 S/T per container [20-foot equivalent unit (TEU)]

  - General supplies – 9 S/T per container

  - Ammunition – 14 S/T per container.

- *Setting CINC JLOTS requirements for JOTE.* After determining the total general cargo requirement for a given reception period, we use the Army interim Heavy Brigade Afloat equipment ratio to translate gross tonnage into the number of vehicles and containers. We then use this information to determine daily throughput requirements. This method for defining JLOTS workloads is consistently applied to all unified command inputs to ensure a uniform approach in defining JLOTS requirements. These requirements will be better defined as the unified commands continue the refinement process and develop time-phased force deployment data (TPFDD) that provides cargo level detail with specific scenarios for JLOTS.

- *Distance from shore.* JLOTS operations were modeled 1 mile from shore. From locations furnished by the unified commands, 1 mile represented the nearest inshore anchorage accessible to deep draft shipping. The JOTE model can accommodate distances ranging from 1 to 50 miles from shore (JLOTS is generally performed 1 to 5 miles from shore). Productivity of conventional lighters and causeways begins to diminish between 3 and 5 miles. That decline in throughput is caused by extending the distance traveled and confronting potentially adverse seas the further from shore an operation is conducted. Cargo is discharged from lighters to either a fixed port or a floating causeway pier.

- *Sea state.* The sea state information for this appraisal was obtained from the Navy Fleet Meteorology and Oceanography Detachment in Asheville, N.C. Data are available on CD ROM. The 12-month average sea state for each location specified by the unified commands is used in JOTE modeling. Service experience and JLOTS Joint Test Directorate trials show that operations effectively halt at SS3. The challenges are ship-to-lighter interface, cargo transfer in rough seas, and safety of operations. Causeway systems are particularly susceptible to these problems. Table B-4 depicts how the risk of not meeting CINC JLOTS throughput requirements increase at higher sea states.

Table B-4.
Sea State Impact on Throughput

Risk	Sea state condition
Low	Sea State 0 to 1.5, 50 percent of time
Medium	Sea State 0 up to 2, 50 percent of time
High	Sea State of 2 or higher, 50 percent of time

Coordination of Service Capability

We assume early coordination will enable Army and Navy lighters to be in position at locations specified by the unified commands. In all cases, when they can reasonably be available we combine self-deploying CONUS-based craft, lighters from the Navy/Marine Corps Maritime Prepositioned Force (MPF), the Army Afloat Prepositioned Force (APF), and Amphibious Task Forces (ATF) to meet CINC requirements. For example, Navy lighters from an MPF squadron link with Army self-deploying vessels and landing craft to form a coordinated JLOTS support package.

Mobility Requirements Study - Bottom Up Review Update (MRS-BURU)

When examining two unified command requirements, Service data from the Mobility Requirements Study – Bottom Up Review Update (MRS-BURU) is translated into cargo tonnage and ship arrival schedules derived from the Model for Intertheater Deployment by Air and Sea (MIDAS). Also, in the case of a third command, new information made available early in our research indicates that the LOTS requirement might be met exclusively by the Army.

Self-Deploying Craft

The LSV self-deploys to JLOTS objective areas. The LCU-2000 can either self-deploy or be loaded aboard the Heavy Lift Prepositioned Ship or another float-on/float-off (FLO/FLO) ship. For the purposes of this assessment, we assume the LCU-2000 self-deploys in support of USACOM, USEUCOM, and USSOUTHCOM requirements. When modeling USCENTCOM and USPACOM JLOTS requirements, we assume all Navy and Army craft, less the LSV, arrive in the objective area aboard Amphibious, Maritime Prepositioned, Afloat Prepositioned, or strategic sealift ships.

the objective area aboard Amphibious, Maritime Prepositioned, Afloat Prepositioned, or strategic sealift ships.

Early Positioning of JLOTS Assets

When lighters are not stationed within a unified command area of responsibility, or may not be available in sufficient quantities, we assume they can be positioned in time to meet CINC requirements. In this case, early positioning specifically relates to the movement of Army craft. It includes the early movement of LSVs or LCUs and the chartering of additional FLO/FLO ships in Northern Europe to move landing craft. Navy causeway ferries and LCM-8s are assumed available based on employment of the MPF or MRS-BURU/MIDAS MPF ship arrival schedules. In those instances where Navy LCU-1600s from the ATF are used, we assumed these lighters had completed their ATF mission and were available.

Amphibious Operations

The potential for the Navy and Marine Corps team to conduct Amphibious Operations in three of the five unified commands was considered when we identified lighters to perform the JLOTS mission. Where we identified Navy LCU-1600s from Assault Craft Units, those lighters were assumed available. However, if the operational situation is such that those craft cannot be released for the JLOTS mission, additional causeway lighters from the MPF could perform those missions that the JOTE model assigned to the LCU-1600. Also, we intentionally set aside causeway lighters from the assault follow-on echelon pool to support amphibious missions. Thus, the unified commanders retained the flexibility for employing and sustaining their amphibious forces while concurrently meeting JLOTS requirements.

APPENDIX C

JLOTS Assessment Briefing Provide to the Joint Warfighting Capabilities and JLOTS Joint Integration Office Working Groups

JLOTS Assessment

Director for Logistics, J-4
The Joint Staff

LMI

1

JLOTS ASSESSMENT

OBJECTIVE: Evaluate the future direction of the DoD JLOTS program through an assessment of CINC JLOTS requirements and Services' capabilities and the impact of emerging technologies to improve or enhance throughput capability.

Assumptions

- Service JLOTS capability has been integrated for joint use based on availability of Navy craft in MPF, Navy Assault Craft Units (LCU-1600) in a CINC AOR and Army watercraft with the APF Theater Opening Force Module
- JLOTS operations effectvely halt at Sea State 3 (SS3)
- JLOTS operations degrade between SS2 and SS3
- Sea State - one element of risk in not meeting CINC JLOTS throughput requirements due to lost operational time:
  - LOW - SS0 to 1.5, 50 percent of time
  - MEDIUM - SS0 up to 2, 50 percent of time
  - HIGH - SS of 2 or higher, 50 percent of time
- JLOTS operations are conducted 1 mile from shore to either a fixed port pier or causeway pier (operations can be modeled 1-50 miles offshore)

2

ASSUMPTIONS (Cont)

- Army Heavy Brigade Afloat ratio of tracks, wheeled vehicles and containers was applied to establish a uniform requirement/capability measurement **when only breakbulk cargo tonnage was provided** by Unified Commands (cargo ratios will change as Service specific TPFDDs are developed)
- Army LSVs and LCU-2000s self-deploy from U. S. East Coast to support USACOM, USCINCSO and USEUCOM requirements
- Army LSVs (2-3) self deploy to support USCENTCOM and USPACOM as an early positioning option
- Near term - MSC charters as an early positioning option up to 2 additional FLO/FLO ships in Europe to move Army watercraft from Hythe, UK and U. S. East Coast to CENTCOM and PACOM (FY97 2nd HLPS delivered)
- JLOTS discharge lanes were assigned based on ship characteristics:
  - RO/RO - 4 lanes, 2 RO/RO lanes with RRDF; 2 LO/RO or LO/LO lanes if ship cranes support
  - Container - 3 lanes w/T-ACS (*although some T-ACS have only 2 crane pedestals, 3 were used for modeling*)
  - Breakbulk - 5 lanes (ships cranes)
- Watercraft availability 85 percent *(actual craft availability is situation dependent)*
- JLOTS II and III test results used in establishing planning factors for watercraft productivity
- Only CINC dry cargo requirements were assessed, liquid cargo requirements were not assessed

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JLOTS ASSESSMENT

FINDINGS

CINC Requirements

- Vary from 25,000 to over 1,000,000 short tons
- *Present CINC information lacks cargo level (TPFDD) detail (Army ground, Marine Amphibious or Air Force) and does not address a requirement for strategic deployment of watercraft to perform JLOTS missions*
- CINC planners are continuing to refine JLOTS requirements
- *CINC JLOTS requirements are based on early entry force closure - **unit tracked and wheeled vehicles and containers*** - need to focus refinement both on early entry force closure and follow-on resupply container and breakbulk requirements

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Joint Over the Shore Transportation Estimator (JOTE) - Excel 5.0

JLOTS II and III Planning Factors - productivity and cycle times:

- Castoff and clear shore
- Transit to ship
- Approach and moor ship
- Loading
- Castoff and clear ship
- Transit to shore
- Approach and moor shore
- Discharge ashore

Services can adjust planning factors to accommodate operational experience or anticipated productivity of different craft

CINC Messages
MRS-BURU Database
MIDAS

CINC requirements Translated into:
- ✓ Tracked Veh ShortTons (S/T)
- ✓ Wheeled Veh S/T
- ✓ Container S/T:
  - Unit Equip
  - General Cargo
  - Ammunition
- ✓ Breakbulk ammunition S/T

C days

watercraft assumed available

number and type of discharge lanes

sea state

JOTE output
- ✓ Selects craft by lane
- ✓ Selects most productive craft based on cargo mix, tons to be moved and type of discharge lane
- ✓ Determines numbers and types of sealift ships required at JLOTS berths to meet CINC throughput requirements

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Watercraft Inventory - as of DEC 1994

Army	Navy
6 LSV	
	(74+17) 91 LCAC
35 LCU-2000	
13 LCU-1600	41 LCU-1600
114 LCM-8	26 LCM-8
23 LARC-LX	
	Causeway Equip (Navy Lighterage))
	52 SLWT
	64 CSP+2
	13 CSP+1
	7 RRDF
	Elevated Causeway Equip
	2 ELCAS (NL) 800 Ft. ea or 1 ELCAS (NL) 1600 Ft.
	(1+1) 2 ELCAS (M) 3000 Ft.
Causeway Equip (Modular)	
(1+6) 7 RRDF	
(1+5) 6 PIER	
(1+8) 9 CSP+3	

Note: Number (+) indicates planned acquisitions.

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Modeling Results

CINC 1: Total Requirement 25,520 S/T
CINC offload site and time not specified
- assumed 4 days

Tracks	2455 S/T
Wheeled Veh	9979 S/T
TEU	13,086 S/T

Number of ships used: 2 RO/RO
2 Container
2 T-ACS

Total Discharge Lanes: 15
SS2 or > 60% High Risk - if to beach
Operation to MCS Pier

Craft and Equipment Assumed Available:

LSV	2
LCU-2000	18
LCU-1600	3
LCM-8	8
CSP+2	4
RRDF	2
CS PIER	1

Result: CINC requirement can be met
SS conditions factored for solution
Requires 1 RRDF and MCS Pier with CONUS outload

Powered Craft Used/Not Used:

LSV	2	0
LCU-2000	18	0
LCU-1600	3	0
LCM-8	0	8
CSP+2	4	0

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Modeling Results

CINC 2: Daily Requirement 6666 S/T

Tracks	890 S/T
Wheeled Veh	2630 S/T
TEU	3146 S/T

Number of ships used: 2 RO/RO
2 Container
2 T-ACS

Total Discharge Lanes: 14
SS2 or > 52% High Risk (1 site protected harbor)
Operation to Fixed/MCS Pier

Craft and Equipment Assumed Available:

LSV	2
LCU-2000	18
LCU-1600	4
LCM-8	8
CSP+2	16 (27)
RRDF	3 (5)
CS PIER	2
ELCAS (NL)	1

Result: CINC Requirement can be met
SS conditions factored for solution
Larger, self deploying craft required to move early entry heavy combat force - 1 MCS RRDF and Pier moved with initial shipping (T-ACS)

Powered Craft Used/Not Used:

LSV	2	0
LCU-2000	13	5
LCU-1600	0	4
LCM-8	0	8
CSP+2	12	4

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Modeling Results

CINC 3: Daily Requirement 7000 S/T

Tracks	1610 S/T
Wheeled Veh	4760 S/T
TEU	630 S/T

Number of ships used: 2 RO/RO
1 Container
1 T-ACS

Total Discharge Lanes: 11
SS2 or > 43% Medium Risk
Operation to Fixed Pier

Craft and Equipment Assumed Available:

LSV	2
LCU-2000	15
LCU-1600	2
LCM-8	6
RRDF	2
CS PIER	1

Result: CINC requirements can be met
SS conditions factored for solution
Requires early positioning of LSVs and MCS/LCUs with FLO/FLO charter. ***2nd HLPS on line in FY97 negates need for charter.*** *12* LCU-2000s self deploy from U. S. East Coast

Powered Craft Used/Not Used:

LSV	2	0
LCU-2000	10	5
LCU-1600	2	0
LCM-8	0	6

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Modeling Results

CINC 4: Daily Requirement 8010 S/T
Phase II

Tracks	1475 S/T
Wheeled Veh	4361 S/T
TEU	1615 S/T
BB GENNOS	559 S/T

Number of ships used: 2 RO/RO
1 Combo RO/RO & BB
1 Container
1 T-ACS

Total Discharge Lanes: 17
SS2 or > 40% Medium Risk
Operations to Fixed Pier

Craft and Equipment Assumed Available:

LSV	3
LCU-2000	7
LCU-1600	6
LCM-8	28
CSP+2	24 (35)
CSP+1	13
RRDF	4 (6)
CS PIER	4
ELCAS (NL)	1

Is there a bare beach scenario for AOR?

Result: CINC requirements can be met
SS conditions factored for solution
Cargo primarily rolling stock thus, higher discharge productivity level. ***Craft needed to support mission 10 days late - affects Phase I force.*** *Earlier movement of CORMORANT required.* ***2nd HLPS required*** *- provides capability without early positioning charter option.* Intracoastal operations likely during Phase II.

Powered Craft Used/Not Used:

LSV	3	0
LCU-2000	7	0
LCU-1600	6	0
LCM-8	0	28
CSP+2	8	16
CSP+1	0	13

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Modeling Results

CINC 5: Daily Requirement 26,799 S/T

SITE 1: 20,279 S/T

Tracks	3998 S/T
Wheeled Veh	11,820 S/T
TEU	4461 S/T

SITE 2: 6520 S/T

Tracks	46 S/T
Wheeled Veh	135 S/T
TEU	67 S/T
TEU (CL V)	1819 S/T
BB CL V	4453 S/T

Number of ships used: 5 RO/RO
SS2 or > 47% Medium Risk 6 Container
Operations to Causeway 5 Break bulk
Pier/ELCAS 6 T-ACS

Given requirement is accurate - ideal location for LSQ/C capability should concept prove feasible

Craft and Equipment Assumed Available:

LSV	3
LCU-2000	18
LCU-1600	6
LCM-8	28
CSP+3	4
CSP+2	18 (29)
CSP+1	13
RRDF	5 (6)
CS PIER	3
ELCAS (NL)	1

Result: CINC requirement cannot be met

Daily Shortfall approximately 12,500 S/T

SS conditions factored for solution - Shortfall will vary dependent on sea state - lower sea state will reduce shortfall

Requirement exceeds capability - affects Phase II force.

The number of discharge points required to compensate for SS conditions would exceed number of ships that could reasonably be expected at berth, cargo handling units, and watercraft capability.

Powered Craft Used/Not Used:

LSV	3	0
LCU-2000	18	0
LCU-1600	6	0
LCM-8	6	22
CSP+3	4	0
CSP+2	18	0
CSP+1	2	11

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Modeling Conclusions

- Based on JLOTS tests planning factors all CINC requirements less CINC 5 can reasonably be met given modeling assumptions and information from the CINCs
- For CINC 5, container and breakbulk ammunition discharge requirements drive the large number of sealift ships, craft and discharge lanes needed - also causes a corresponding increase in cargo handling units - location precludes contract HNS
- Model indicates need to forward station craft (LSV, LCU and causeways) in CINC 5 AOR
- Model will automatically select the LSV, then LCU-2000 and finally the LCU-1600 before causeways when moving rolling stock - the CSP+2 is selected predominately in the container movement role - *Craft mix will change with further refinement of CINC requirements particularly when breakbulk and container cargo are added*

Summary of Dual MRC Requirements

Craft	Inventory	No. used
LSV	6	6
LCU-2000	35	25
LCU-1600	54	12
LCM-8	103	6
CSP+2	64	21
CSP+1	13	2

Summary of Most Demanding MRC and LRC Requirements

Craft	Inventory	No. used
LSV	6	5
LCU-2000	35	36
LCU-1600	54	9
LCM-8	103	6
CSP+2	64	22
CSP+1	13	2

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Assessment Matrix

	CINC 1	CINC 2	CINC 3	CINC 4	CINC 5
Sea State - High Risk	H	H	M	M	M*
Requires Early Positioning			X	X	X
Requires ACU				X	X
Requires 2nd HLPS			X	X	X
Fwd Station/Deploy					X
LSQ/C					X
Requires Strat Lift	X	X	X	X	X
Requires CSP	X	X		X	X
Impact Maneuver Force	None	None	None	Yes	Yes

*Sea State becomes a higher risk factor for CINC 5 because of the large JLOTS throughput requirement.

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INVESTMENT COST

Service	Unit	Total Units	Craft Inventory	Acquisition Cost ($M-FY95)	Unit O&M Cost (FY95 $M)
Army	LSV Det	6	6 LSV		$12.5
	Hvy Boat Co	5	35 LCU- 2000 (1 TDA) 13 LCU-1600		$55.9
	Med Boat Co	4	114 LCM-8 (32 TDA)		$35.6
	LARC-LX Det	4	23 LARC-LX		$5.2
	MCS RRDF Det	7	1 MCS RRDF		$2.8
			6 MCS RRDF	$27.4	$17 when fielded
	MCS Pier Det	6	1 MCS Pier		$2.7
			5 MCS Pier	$25.6	$13.6 when fielded
	MCS CSP+3 Det	9	1 MCS CSP+3		$1.5
			8 MCS CSP+3	$14	$12.2 when fielded
	Total Army		**180 (plus 33 TDA)**	**$67M**	**$159M**
Navy	ACU (LCAC)	2	74 LCAC		$74
			17 LCAC	$272	$17 when fielded
	ACU (LCU-1600)	2	41 LCU-1600 (6 other units)		$55.4
	MPSRON	3	26 LCM-8 (2 other units)		$20.6
	PHIB CB	2	52 SLWT		$13.3
	PHIB CB		64 NL CSP+2		$32.6
	PHIB CB		13 NL CSP+1		$6.6
	PHIB CB		7 NL RRDF		$3.7
	PHIB CB		2 ELCAS (NL)		
	PHIB CB		1 ELCAS (M)	$14	$3.4
			1 ELCAS (M)	$40	$3.4 when fielded
	Total Navy		**282 (plus 8 other units)**	**$326M**	**$229.8M**
TOTALS			462 (plus 41 TDA and other units)	$393M	$388.8M

Notes:
1. O&M costs include personnel.
2. Army cost data obtained from CAA Cost Model.
3. Navy costs obtained from:
   a. LCAC Program ManagementOffice
   b. NL Program Management Office
   c. LCU-1600/LCM-8 - the Army CAA cost model for like units.
4. (Other) designates craft not available for JLOTS.

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Service Capability - Background

- Army and Navy developed programs and force packages to move organic forces
  - Army - Heavy Divisions - LOTS, intracoastal and riverine operations
  - Navy - Amphibious Operations - LOTS, limited intracoastal and riverine operations

Navy - Maritime Prepositioned Force & AFOE   Army - Afloat Prepositioned Force

- LSV, LCAC, LCU-2000 and LCU-1600 most versatile and productive craft for moving heavy forces (tanks and vehicles) - LCM-8 is the least productive of the landing craft (jeep of the watercraft fleet - cargo handler shift change, ambulance, C2)
- Causeway Ferry is deployable on available lift assets and most productive container mover close inshore under ideal sea state conditions (significant wave height 1 foot or less) - ELCAS pier needed mid to late period to handle container and breakbulk volume

Key

- **Causeway RO/RO Discharge Facilities (RRDF) and floating Piers have increased productivity 100% by replicating as near as possible instream to fixed port operations while capitalizing on the higher productivity of the LSV, LCU-2000 and LCU-1600**
- Army LOTS employs large support vessels/landing craft (LSV and LCU-2000)
- Navy LOTS employs causeway ferries and other watercraft in conjunction with floating and elevated causeway piers
- Navy considers LCAC and LCU-1600 as Amphibious operations craft capable of supporting assault, then sustainment phases (LOTS/JLOTS) - ongoing effort with N42, N85 and USMC to expand LOTS role for these craft

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CONCLUSIONS

Requirements and Capabilities

- All stated CINC JLOTS requirements *cannot* be met despite the capabilities of the current Joint watercraft fleet
- *CINC 5 significant requirement for containerized and breakbulk ammunition is inherently the most laborious and time consuming mission for JLOTS*
- *A reconfirmation of CINC 5 requirements is necessary*
- *Causeway RRDF and Pier improve throughput 100%* - expands utilization of most productive Army craft
- *LCM-8 is not the most optimal JLOTS asset - but has an important operational support role* - there is a need to identify all requirements for this boat
- *Navy previously did not incorporate the LCAC or LCU-1600 in Navy LOTS or JLOTS*
- *Service LOTS should be available for JLOTS missions at the discretion of the Unified Commander or subsequent to dissolution of the Amphibious Task Force or when the ATF is not required* - each Service has unique capabilities that when combined offer the CINC a potent and flexible logistics support option for maneuver warfare

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Recommendations

Requirements and Capabilities

- Service LOTS forces be available for JLOTS missions at the discretion of the Unified Commander or subsequent to the dissolution of the Amphibious Task Force or when the ATF is not needed
- Navy continue incorporation of the LCAC and LCU-1600 in JLOTS
- CINC 5 reconfirm JLOTS requirements
- A further assessment of total CINC requirements that incorporates dry cargo, fuel and water requirements be accomplished (fuel requirements should build upon Navy OPDS studies)

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Acquisitions and Retirements

- Navy has multi-year procurement for 17 additional LCACs with delivery between FY95-97 cost $272M
- Army is considering divesting some LCM-8s by FY02
- Navy has a scheduled delivery in February 1995 for 1 double wide 680 ft. elevated modular causeway pier - ELCAS (M).
- Navy has funds available and is currently negotiating to buy additional modular causeway roadway sections that extend the ELCAS (M) to 2000 ft. - cost $17.5M
- Navy will procure a second ELCAS (M) by FY99-00 only if the prototype passes Operational Evaluation (OPEVAL) in April 1995 - cost $40M
- Navy has programmed for the normal replacement of worn-out NL causeway lighterage - 7 years $25.5M
- Navy is considering a new start under Program Review 97 for modular ACVLAP in support of LCAC LOTS operations
- Army plan is to procure approximately 19 modular causeway systems - approximate cost $67M
- Army has contracted for 6 of 19 modular causeway systems (6 CSP+3) - cost $10.5M

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CONCLUSIONS

Acquisition and Retirements

- Army should identify all operational requirements for the LCM-8 and maintain an inventory level that reflects and supports these requirements
- *Service acquisition programs are not fully synchronized -*
  - Army should focus procurement of modular causeway sections on enhancers for the LSV and LCU-2000 (MCS RRDF and MCS Pier) - Navy has sufficient NL causeways to perform CINC AFOE and JLOTS causeway ferry missions

    Note: CINC requirements did not specify separate Amphibious and JLOTS operations - coordinated JLOTS force packages were built for each Unified Command requirement less CINC 3 - using this approach sufficient Navy causeways were available to perform the causeway ferry missions

  - Navy plan is to procure a second ELCAS (M) only if the prototype passes OPEVAL - testing will determine assembly and installation time and interface with the Army LSV and LCU-2000 - should also be determined whether the ELCAS (M) can be installed and operational in time to meet CINC 5 container and breakbulk ammunition requirements
  - Navy plan is to obtain a more capable system than first generation NL and second generation MCS lighterage - decision is to continue procuring replacement sections for NL causeways as the advanced modular causeway system is being developed - NL causeways were found not to be fully interoperable (NL RRDF, ELCAS and Floating Pier) with Army LSV/LCU-2000 as cited during JLOTS exercises and tests
  - Navy is exploring options to build ACVLAP (PR 97) - *allows LCAC to become a JLOTS system*

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Recommendations

Acquisitions and Retirements

- Army determine JLOTS operational support missions for the LCM-8 and assess whether the inventory exceeds Service requirements
- Army procure only those modular causeway sections necessary for 6 RRDFs and 5 Causeway Piers - approximate cost $53M (final configuration and size of RRDFs and Piers has not been determined - it is likely additional sections will be required and programmed)
- Army not procure additional modular causeway powered sections for the MCS Ferry - potential savings $1.9M (savings may not be realized if requirement for causeway sections to build RRDFs and Piers increases)
- Navy execute contract to buy needed modular sections to complete 2000 ft. ELCAS (M) - cost $17.5M
- Navy conduct planned OPEVAL of ELCAS (M), testing interoperability and ability to meet CINC 5 warfighting requirements - if OPEVAL supports procurement, cost of a second system cost is $40M - if OPEVAL does not support, potential savings is $40M
- Navy fund new start to procure ACVLAP to support use of LCAC in LOTS/JLOTS operations - estimated cost is $13.5M for 3 ACVLAP (1 per MPSRON)

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Sea State and Capability

- Sea State 3 (significant wave height 3.5-5 feet) halts JLOTS
- Sea State information for CINC littoral areas derived from Navy Fleet Meteorology and Oceanography Detachment, Asheville, NC data (CD ROM)
- JLOTS is more likely to be conducted to a fixed pier than bare beach (JLOTS operations can be in full fixed ports, limited and restricted access ports and bare beach)
- Craft, lighterage and ship interface systems are not effective for *cargo transfer* in SS3 (exception LCAC when operating from a well deck ship)
- Adverse SS can be mitigated:

  Near Term:
  - Increasing the number of instream JLOTS offload berths employing multiple RRDFs and T-ACS to attain a higher production rate that compensates for lost time
  - Locating JLOTS operations within protected anchorage or harbors and avoiding open ocean exposure

  Long Term - potential technology solutions:
  - Advanced crane technology
  - Navy advanced modular causeway lighterage system
  - Landing Ship Quay/Causeway

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Conclusions

Sea State

Adverse sea state conditions are mitigated:

- *in the near term by increasing the number of discharge RO/RO and LO/LO lanes (RRDFs and T-ACS) and site selection*
- *longer term by employing a system of systems approach with advanced technology*

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Recommendation

Sea State

Services continue mid- and long-term RDT&E programs incorporating advanced crane technology, the advanced modular lighterage system, and LSQ/C

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Force Structure

- Army AC/RC mix for LSV Det and Heavy Boat Company may be unbalanced if craft are forward stationed or forward deployed (crewed)
- Army cargo handling capability is marginally adequate for single MRC - basic rule is 7 terminal service units to a MRC (4 AC/3 RC - 1 per berth) - JLOTS is additive only with assignment of additional cargo handling units (Army has total of 13 terminal service units). Most likely scenario is a partial fixed port/JLOTS split with the 7 units - early RC call-up needed to support MRC - *RC activated at C030 in previous study*
- Navy AC/RC mix in Amphib Construction and Cargo Handling battalions requires early call-up - 2 AC Amphib Construction and Cargo Handling battalions can discharge 1 MEB (MPSRON) instream in 5 days, Amphib Construction battalions are designed with RC trace; total of 2 AC and 12 RC Cargo Handling battalions
- Workable solutions require an integration of Service capability
- Workable solutions may require forward stationing of LCU-2000s and/or LSVs (Army implement 1993 CSA Decision)

Early Call-up of Army and Navy RC Critical!

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Conclusion

Force Structure

Further analysis of Services' force structure is required - the impact of forward stationing and deployment of watercraft units should be determined along with the ability of cargo handling units to be deployed or activated and deployed to meet CINC JLOTS requirements

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Recommendations

Force Structure

- Services assess adequacy of their AC/RC mix and ability to support early CINC JLOTS requirements concurrent with MRC fixed port operations
- Services assess adequacy of AC Cargo Handling Units and probability of RC call-up
- Joint Staff, Services and TRANSCOM analyze the need for forward stationing and/or deploying lighterage and watercraft in support of CINC JLOTS requirements

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Interoperability - important OV 93 JLOTS III findings:

- *Command and control and training were deficient*
- Army and Navy causeway systems should be standardized - Navy next generation CS should be modular and compatible with Army MCS (*next generation Navy advanced lighterage system will be designed for interoperability)*
- Navy elevated causeway pier and crane did not interface well with larger Army craft (LSV and LCU-2000) due to crane reach and mooring stability (*developed prior to LSV and LCU-2000, the ELCAS (NL) is interoperable with causeway ferries and LCU-1600)*
- JLOTS Joint Test Directorate recommends the planning factor for installation of the Navy 3000 ft. ELCAS (NL) be changed from 7 to 30 days (offload, assembly and installation) - (*OPEVAL for ELCAS (M) should establish planning factor for new modular system [requirement 3000 ft. in 7 days])*
- Fendering on Army and Navy causeway systems was inadequate causing lighter interface problems
- Ship RO/RO ramps must be certified for instream discharge
- *Operations in SS3 are not viable with existing ship, watercraft and beach interface systems*
- Joint Pub 4-01.6 productivity planning factors are too high (productivity planning factors using RRDF are not established)

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Conclusions

Interoperability

- *Frequent and rigorous Joint training will overcome training and C2 deficiencies* - TRANSCOM has taken the lead for injecting JLOTS in CINC exercises
- *There is a need to certify RO/RO ramps for RRF RO/ROs*
- *The Joint Staff JLOTS Joint Integration Office is the appropriate forum to address interoperatility and JTTP for the employment of JLOTS forces.*

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Recommendations

Interoperability

- Joint Staff, CINCs and Services provide funding and opportunities for JLOTS training in JCS-sponsored exercises
- TRANSCOM continue efforts to certify ramps on RRF RO/RO ships
- Joint Staff J-4, JLOTS Joint Integration Office be designated the OPR to coordinate and facilitate the integration of JLOTS programs, to enhance interoperability between Service LOTS programs, and for coordinating solutions to JLOTS issues and problems
- Joint Staff J-4, Services, and TRANSCOM update Joint Pub 4-01.6 planning factors and incorporate doctrinal changes developed during the Joint Pub review process

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RDT&E and Emerging Technology

- Army is focusing current program on SLEP and upgrades for existing craft and improving interoperability (fendering) of the RRDF and CS Pier with the LSV and LCU-2000 - funded at $3.9M thru FY96
- Navy's Carderock Division, NSWC has successfully tested the LCAC carrying an M1A1 in the fly-on/off mode using an Air Cushioned Vehicle Landing Platform (ACVLAP) - estimated cost of ACVLAP is $4.5M (current cost of MCS RRDF)
- Navy has submitted for advanced technology demonstration a proposal for an Advanced Modular Causeway Lighterage System capable of operations in SS3 (significant wave height 3.5-5 feet) as required by Navy doctrine - if ATD proves successful, Navy will be able to field system that is capable of SS3 operations, increases payload capacity by 200-300%, and is readily deployable with available lift assets - RDT&E funding required for concept and advanced development thru FY99 is $10.1M
- ARPA is assessing a 6 degree of freedom robotic spreader bar - R&D cost NTE $2M
- ARPA is also assessing the LSQ/C as a stable platform capable of discharging cargo onto an elevated causeway in SS3 - R&D cost $8M

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Conclusions

RDT&E and Emerging Technology

- *Army and Navy RDT&E funding is at minimal levels* - Services are pooling their engineering support thru the Navy's Carderock Division, NSWC - further collaboration in Joint MNS and ROC development is needed to establish a requirement for a continuous funding stream for joint research and development
- *ATD Navy Advanced Modular Causeway Lighterage System should be fully funded* - ATD will determine whether cargo can be delivered ashore in SS3 in less time and at less cost than current NL and MCS capability - system should interface with LSV and LCU
- *Technology - two potential enhancers - R&D is needed on emerging crane technology and the LSQ/C* - technology offers potential for operations at SS3 at less cost, in less time and with less structure than current JLOTS force

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Recommendations

RDT&E and Emerging Technology

- Navy fund ATD for Advanced Modular Causeway Lighterage System - cost $10.1M
- ARPA continue ATD for Advanced Crane Technology - R&D cost NTE $2M
- ARPA continue RDT&E on LSQ/C - schedule completion NLT FY97 as an alternative to early positioning option/forward stationing and SS3 conditions - R&D cost $8M

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Future Technologies

- Air Cushioned Bridging (ACB) system - lightweight, rapidly deployable causeway system employing a air supply valving and manifold system where air supply valves open before and close after load is moved along causeway sections - innovative deployment scheme extends ACB unit by pressurizing the manifold tubes (party whistle effect)
- Ship "Outrigger" Transfer System - fold down platform on side of vessel that functions as a piece on which ACVs fly-on/off with cargo moved to the platform via an opening in the side of the ship or lowered from topside with the ship's crane - platform is attached to the hull near the water line by a hinge mechanism that allows the outrigger system to pivot and thus heave as a function of sea state and platform loads
- Heavy Lift Air Taxi (H-LAT) - based on the powered modified harnessed parafoil (kite and sport parachute with gliding and steering characteristics) - concept not affected by surface obstacles and able to project payload inland up to 500 miles at speed of approximately 100 MPH - H-LAT launched from ships with flight deck or floating pontoon landing platform
- Very High Speed Ferry Vessel - shallow draft vessel capable of operating at 60-80 knots employing a four hull (quadrimaran) design with low freeboard beaching capability - will be designed in passenger and RO/RO configurations

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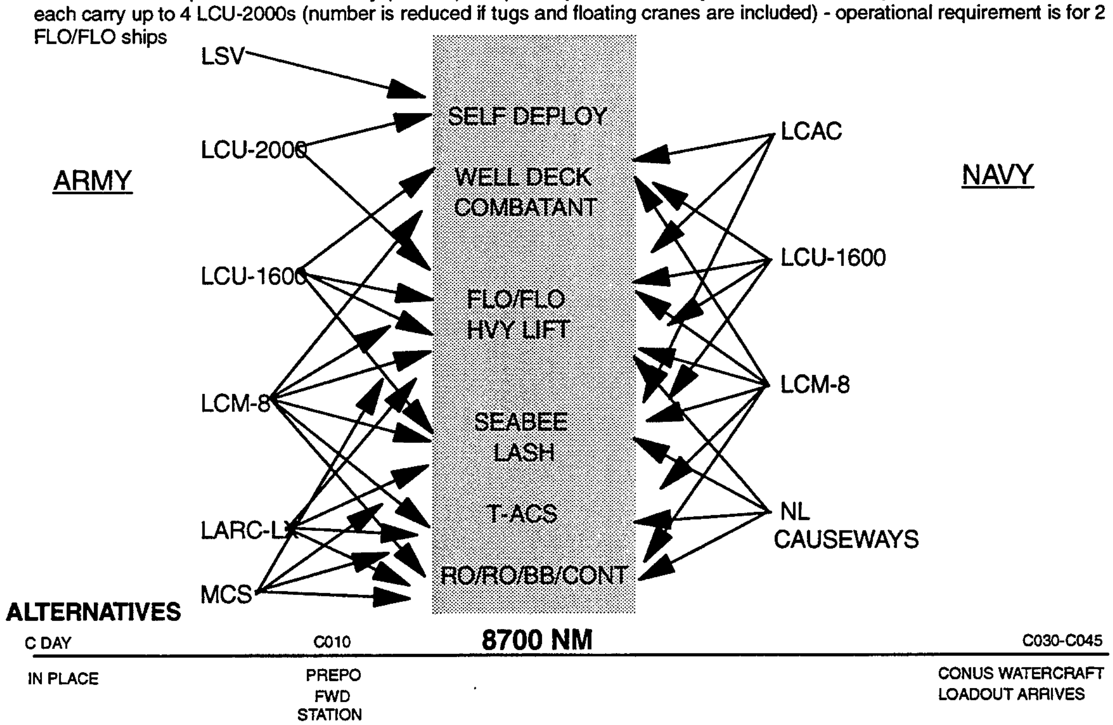
Deployability

- There is a need for the Services to assess how their most productive craft (LSV, LCAC, LCU-2000, LCU-1600 and causeways) can best be positioned to support PACOM and CENTCOM requirements; Army plan is to lease a second FLO/FLO ship in FY97 - cost for the 2 ships is $26.3M annually (FY95 $) - ships are part of the Army's AWR-3 Afloat Prepositioned Force and can each carry up to 4 LCU-2000s (number is reduced if tugs and floating cranes are included) - operational requirement is for 2 FLO/FLO ships



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Conclusions

Deployability

- *Further analysis of forward stationing and deployment options for CONUS-based watercraft is needed* - early CINC requirements identify a need for the larger, more productive craft - Navy and Marine Corps have identified 2 of 3 SEABEE ships to transport NL causeways for the offloading of the AFOE - adding Navy and Army LCU-1600s transported in these ships provides a more robust mix of craft to support CINC requirements - Army must determine how best to deploy the LARC-LX (amphibian) with beach preparation and salvage capability)
- CINCs identify requirements for JLOTS forces in TPFDD in conjunction with deliberate planning process - TRANSCOM has developed JLOTS force packages that can serve as guides for developing CINC specific packages
- *Assessment supports Army requirement for second FLO/FLO ship* - provides continuous JLOTS capability with APF

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Recommendations

Deployability

- TRANSCOM, regional Unified Commands and Services develop *coordinated fixed port and JLOTS operating packages* to support force projection operations using a system of systems approach
- Regional CINCs identify requirements for JLOTS forces and strategic sealift - include early lift of watercraft and JLOTS force packages in TPFDDs developed in conjunction with current deliberate planning cycle
- TRANSCOM and Services develop procedures for early lift of watercraft and JLOTS force packages to meet CINC requirements
- Army fund lease of 2nd FLO/FLO - annual cost $13.2M

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Recommendations

The Top 1 Plus Ten - A recap

- ***Train the JLOTS Force*** **- ALL**

1. Accelerate leasing process for second FLO/FLO - Army
2. Assess need to forward station Heavy Boat Company - Army
3. Develop coordinated fixed port and JLOTS support packages - TRANSCOM, regional CINCs and Services
4. Develop procedures for early lift of watercraft and JLOTS force packages - TRANSCOM, regional CINCs and Services
5. Identify requirement for JLOTS forces and strategic lift in TPFDD - regional CINCs
6. Assess adequacy of JLOTS and fixed port force structure and AC/RC mix - Army and Navy
7. Buy MCS RRDFs and Piers - Army
8. Buy integrated ACVLAP/RRDF (modular) - Navy
9. Relook need for second ELCAS (M) - determine through OPEVAL ability of ELCAS (M) to meet CINC requirements - Navy
10. PUSH RDT&E - LSQ/C, modular lighter system and crane technology - ARPA and Navy

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Recommendations

Spending DoD $ - An Acquisition and RDT&E recap

GO	NO GO (Service Determination)	PAUSE (Service Determination)	COST	POTENTIAL SAVINGS
MCS RRDF (6) A MCS Pier (6) A			$53M	
	MCS CSP+3 A			$1.9M
		LCM-8 (if -18) A Army will determine inventory level for this craft based on JLOTS support requirements		$3.9M
ACVLAP (3) N			$13.5M	
NL Replacement N			$25.5M	
ELCAS (M) Sections N			$17.5M	
		2nd ELCAS (M) N Pending OPEVAL - System becomes GO or NO GO based performance tests		$40M
AMCLS RDT&E N			$10.1	
Crane Tech R&D ARPA			$2M	
LSQ/C R&D ARPA			$8M	
Total			$129.6M	$45.8M

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APPENDIX D

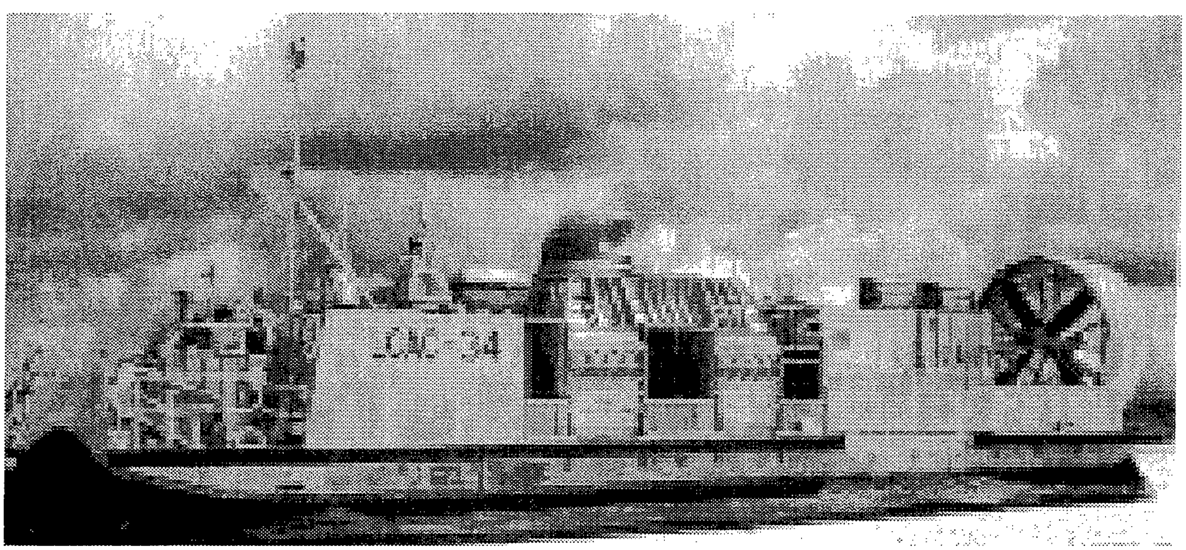
Lighter Descriptions and Joint Logistics Over the Shore Diagrams

Landing Craft, Air Cushioned (LCAC) - Navy

Inventory objective: 91
Number on hand: 89 (includes production)
Cost: $17 million (1994)

Mission: To transport cargo from ship to shore in amphibious operations
Transportability: Navy amphibious ships and commercial barge ships
Cruising range: 110 nautical miles (one round trip in SS2) with a payload of 85 short tons
Length, overall: 87 feet, 11 inches
Beam: 47 feet
Speed: 40 knots fully loaded
Cargo capacity: Rated at 60 short tons; however, on a "standard day" (SS2 with temperature between 60EF and 80EF), the LCAC can carry 75 tons
Crew: 5

Representative loads: 1 M1A1 tank and 3 HMMWV, or
4 trucks and 3 HMMWV, or
2 AAV and 4 HMMWV, or
2 LVS and 4 HMMWV, or
9 HMMWV

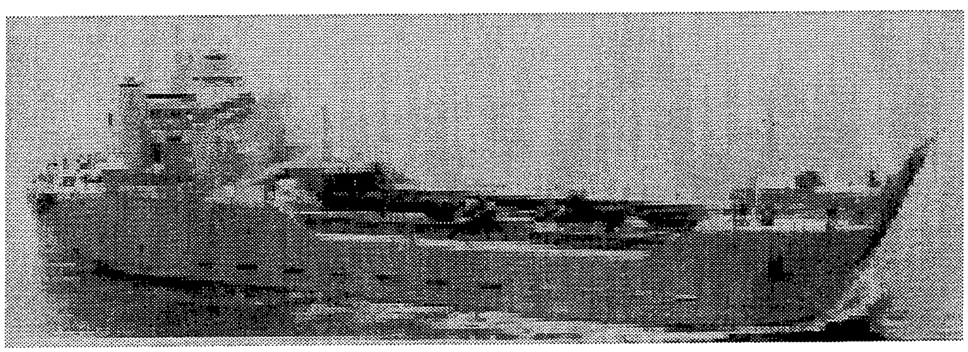


LOGISTICS SUPPORT VESSEL (LSV) – ARMY

Inventory objective: 6
Number on hand: 6
Cost: $16 million (1995)

Mission: To transport cargo in ocean, coastal, and inland waterways
Transportability: Self-delivery
Cruising range: 8,200 nautical miles empty; 5,500 nautical miles loaded
Length, overall: 272.75 feet
Beam: 60 feet
Draft (max): 12 feet
Speed: 11.5 knots loaded
Cargo capacity: 2,000 short tons with 10,500 square feet of deck space
Crew: 31

Representative loads: 24 M1A1 tanks, or
50 wheeled vehicles, or
50 twenty-foot containers (double stacked)

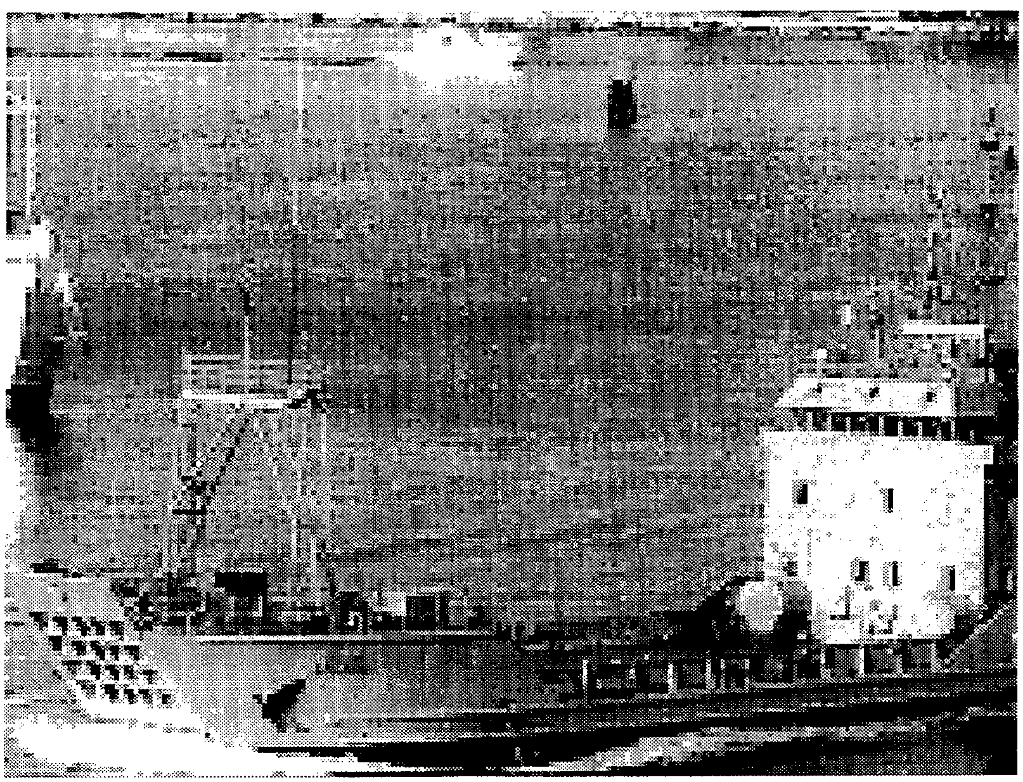


LANDING CRAFT, UTILITY (LCU-2000) - ARMY

Inventory objective: 51
Number on hand: 35
Cost: $4 million (1995)

Mission: To transport cargo from ship offshore to shore and in areas that cannot be reached by ocean-going vessels. Vessel can operate on coastal waters and on the open ocean.
Transportability: Self-delivery; however, preferred method is heavy lift or float-on/float-off ship
Cruising range: 4,500 nautical miles
Length, overall: 175 feet
Beam: 42 feet
Draft, loaded: 4 feet forward, 9 feet aft
Speed: 11 knots fully loaded
Cargo capacity: 350 short tons with 2,500 square feet of deck space
Crew: 13

Representative loads: 5 M1A1 tanks, or
13 wheeled vehicles, or
28 twenty-foot containers (double stacked)

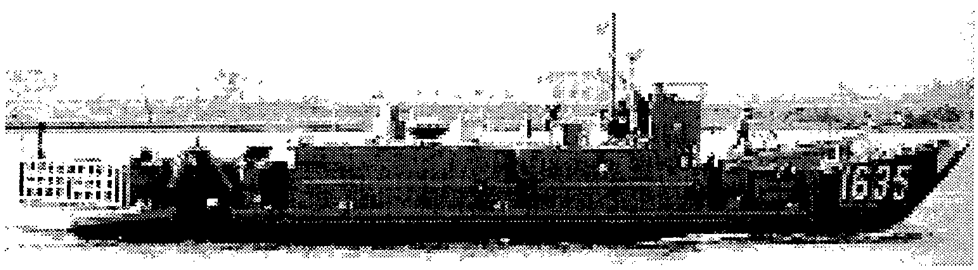


Landing Craft, Utility (LCU-1600 Class) – Navy and Army

Inventory objective: Navy - 41; Army - 13
Number on hand: 54
Cost: $3 million (1986)

Mission: To transport cargo, troops, and vehicles from ship to shore, shore to shore, or in retrograde movements; may be used for lighterage and utility work in harbors and inland waterways
Transportability: Amphibious ships, deck loaded on commercial ships, heavy lift, SEABEE, or float-on/float-off ships
Cruising range: 1,200 nautical miles empty or loaded
Length, overall: 135 feet
Beam: 29 feet
Draft, loaded: 3 feet, 2 inches forward; 6 feet, 5 inches aft
Speed: 11 knots fully loaded
Cargo capacity: 187 short tons with 1,800 square feet of deck space
Crew: 13/14

Representative loads: 2 M1A1 tanks, or
4 wheeled vehicles, or
8 twenty-foot containers (double stacked)

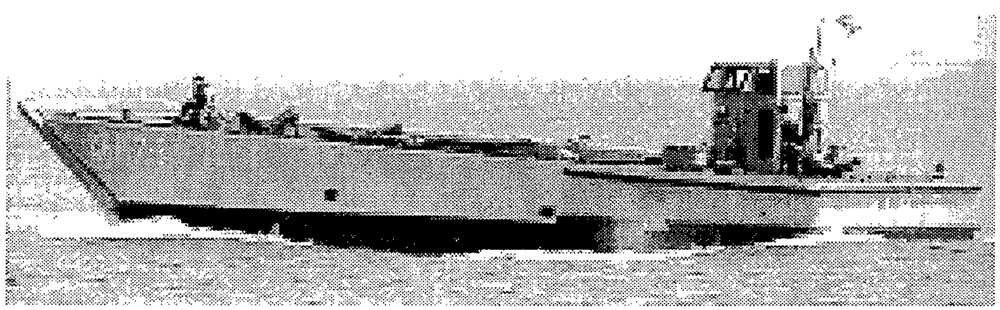


Landing Craft, Mechanized (LCM-8) - Navy and Army

Inventory objective: Navy-60; Army-114
Number on hand: 174
Cost: $600,000 (1986)

Mission: To transport cargo, troops, and vehicles from ship to shore, shore to shore, or in retrograde movements. May be used as lighter in harbor and inland waterways.
Transportability: Deck loaded on any commercial cargo ship, SEABEE, or float-on/float-off ship
Cruising range: 271 nautical miles loaded
Length, overall: 73 or 74 feet
Beam: 21 feet
Draft, loaded: mean 4 feet, 7 inches
Speed: 12 knots loaded
Cargo capacity: 65 short tons with 620 square feet of deck space
Crew: 5

Representative loads: 1 light-tracked vehicle (M60 tank and under)
1 wheeled vehicle (tractor/trailer)
1 twenty-foot container



Causeway Ferry or Causeway System, Powered (CSP) - Navy and Army

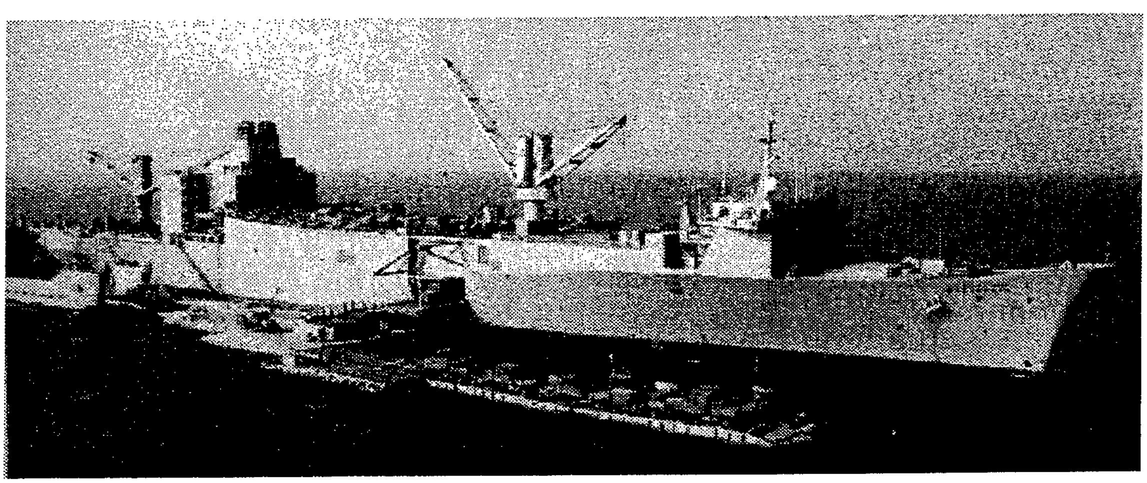
Inventory objective: Navy-64 CSP+2s (Navy can build CSP+3 systems by adding an additional 90-foot section); Navy-13 CSPs+1s; Army-8 CSP+3s
Number on hand: Navy-64 CSP+2s; Navy-13 CSP+1s; Army-1 CSP+3
Cost: Navy will spend, on average, $2.5 million annually for replacement non powered causeway sections. Army will spend $1.75 million per CSP+3s

Mission: To provide a rapid means of transporting rolling stock and containers/breakbulk cargo from ship to shore in LOTS or JLOTS operations
Transportability: All Navy and commercial cargo ships and LSTs
Length overall and beam: Dependent on the number of sections brought together to build a causeway ferry:

- ► Navy causeway sections are 90 feet long, 21 feet wide with a 90-ton capacity; and
- ► Army modular causeway sections are 12 feet wide and 40 feet long with a capacity of 70 tons (when two sections are linked in parallel)

Speed: 5 knots loaded
Cargo capacity: 350 short tons (CSP+3)
Crew: 5

Representative loads: 3 M1A1 tanks, or
16 wheeled vehicles, or
24 twenty-foot containers



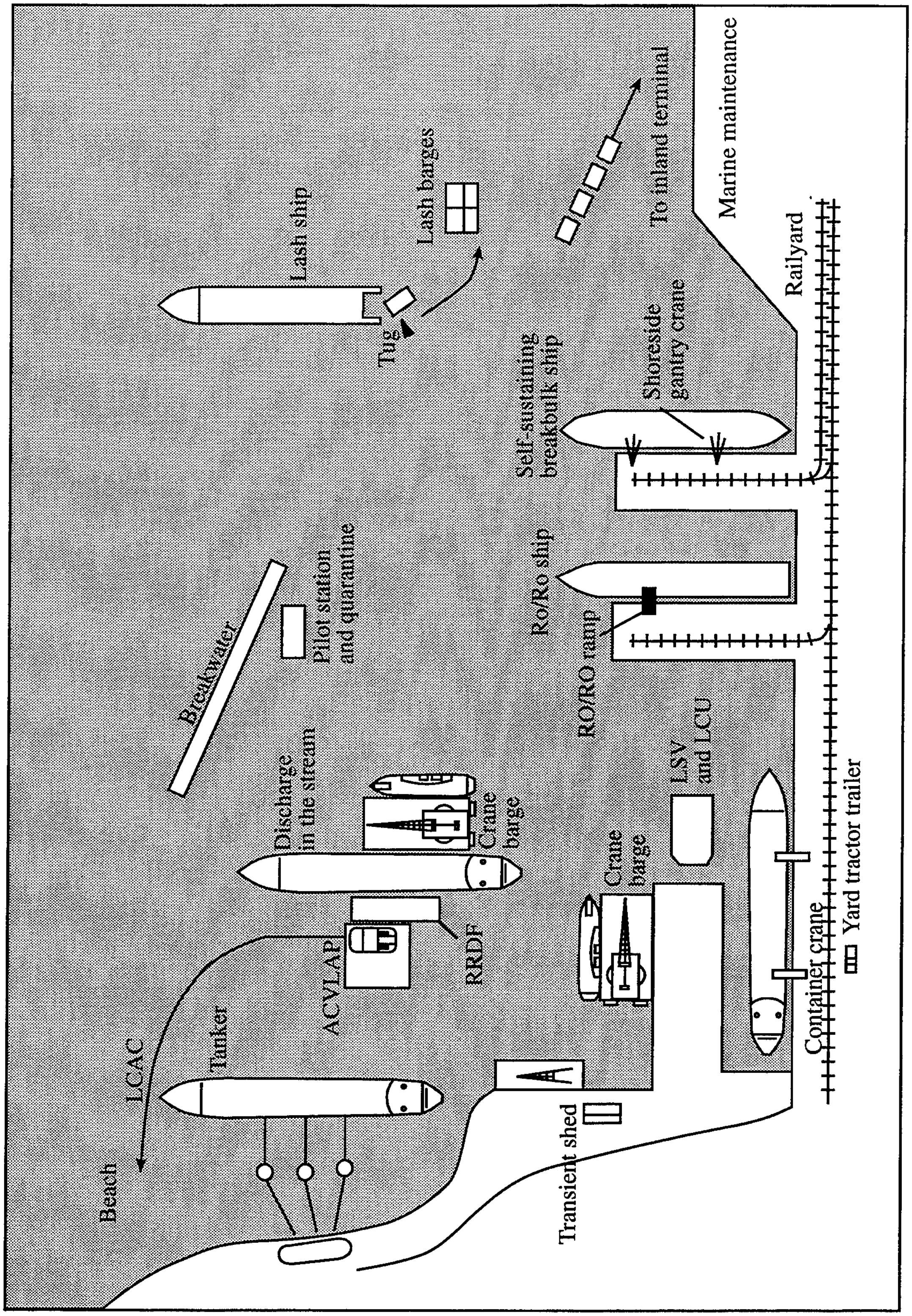


Figure C-1.
LOTS Operations Area (Fixed Port Augmentation)

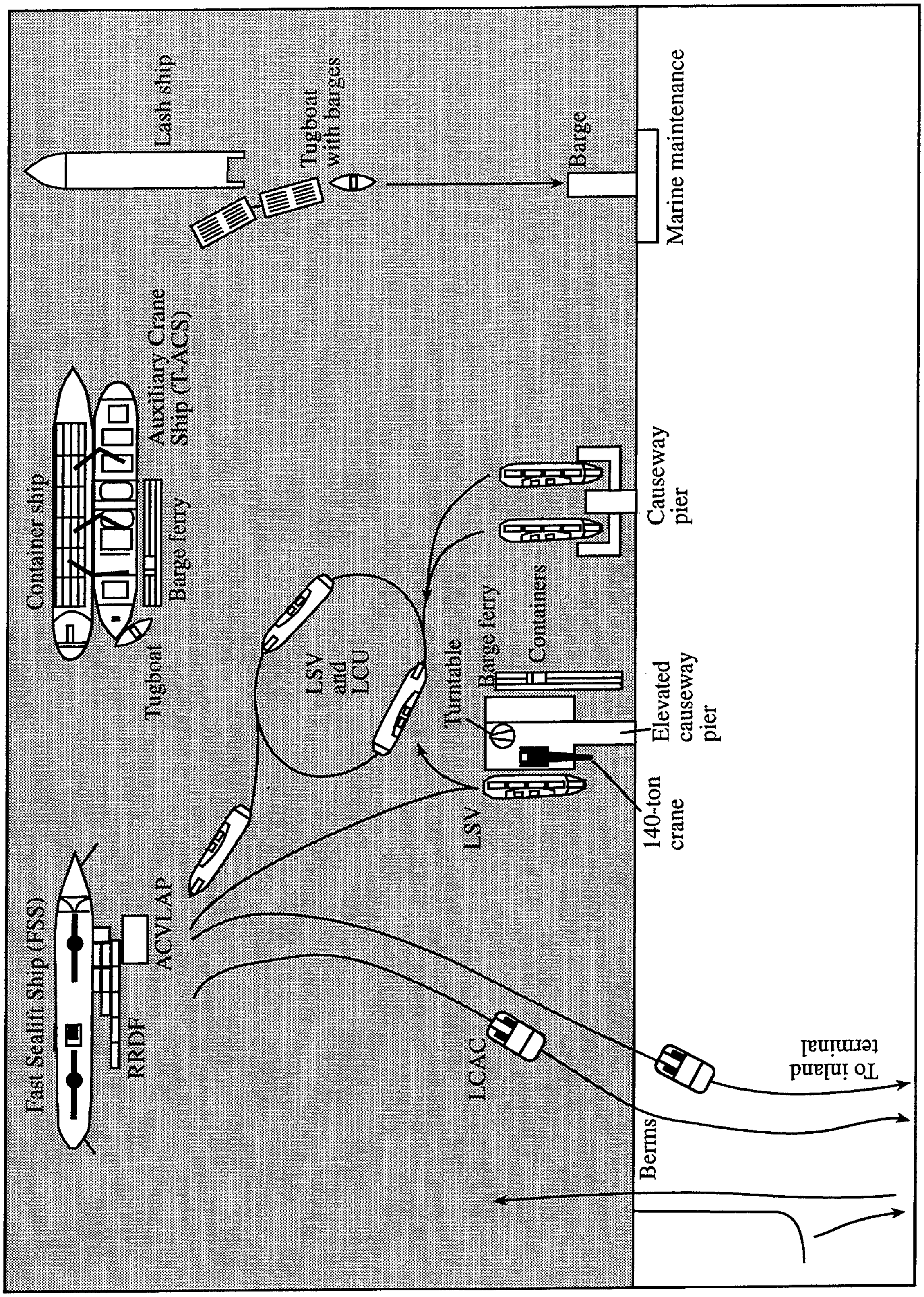


Figure C-2.
LOTS Operation Area (Bare Beach)

APPENDIX G

Glossary

Glossary

AAV	=	Amphibious Assault Vehicle
AC	=	Active Component
ACB	=	Air Cushioned Bridging
ACV	=	air-cushioned vehicle
AOR	=	area of operation
ARPA	=	Advanced Research Projects Agency
ACVLAP	=	Air Cushioned Vehicle Landing Platform
APF	=	Afloat Prepositioned Force
ATD	-	advanced technology demonstration
ATF	=	Amphibious Task Force
AWR	=	Army war reserve
BB GENNOS	=	breakbulk general cargo not otherwise specified
CINC	=	Commander in Chief
CONPLAN	=	concept plan
CS	=	Causeway System
CSP	=	Causeway System, Powered
DoD	=	Department of Defense
dwt	=	deadweight tons
ELCAS	=	Elevated Causeway System
ELCAS (M)	=	Elevated Causeway System (Modular)
ELCAS (NL)	=	Elevated Causeway System (Navy Lighterage)
FLO/FLO	=	float-on/float-off

FSS	=	fast sealift ship
H-LAT	=	Heavy Lift Air Taxi
HLLCAC	=	Heavy Lift Landing Craft, Air Cushioned
HLPS	=	heavy-lift prepositioned ship
HMMWV	=	High Mobility Multi-purpose Wheeled Vehicle
HNS	=	host nation support
IFC-GOSC	=	Improving Force Closure – General Officer Steering Committee
JCS	=	Joint Chiefs of Staff
JIO	=	Joint Integration Office
JLOTS	=	Joint Logistics Over the Shore
JOTE	=	Joint Over the Shore Transportation Estimator
JROC	=	Joint Requirements Oversight Council
JTD	=	Joint Test Directorate
LCAC	=	Landing Craft, Air Cushioned
LCM	=	Landing Craft, Mechanized
LCU	=	Landing Craft, Utility
LMI	=	Logistics Management Institute
LMSR	=	large, medium speed roll-on/roll-off ship
LO/LO	=	lift-on/lift-off
LOTS	=	Logistics Over the Shore
LSQ/C	=	Landing Ship Quay/Causeway
LSV	=	Logistics Support Vessel
MCS	=	modular causeway system
MEB	=	Marine Expeditionary Brigade

MHE	=	materials handling equipment
MIDAS	=	Model for Intertheater Deployment by Air and Sea
MNS	-	mission needs statement
MPF	=	Maritime Prepositioned Force
MPSRON	=	Maritime Prepositioned Squadron
MRC	=	major regional contingency
MRS-BURU	=	Mobility Requirements Study-Bottom Up Review Update
MT	=	measurement ton
MTMC	=	Military Traffic Management Command
NL	=	Navy lighterage
NLT	=	not later than
NSWC	=	Naval Surface Warfare Center
NSWCCD	=	Naval Surface Warfare Center, Carderock Division
NTE	=	not to exceed
OOTW	=	operations other than war
OPEVAL	=	operational evaluation
OPLAN	=	operations plan
OPR	=	office of primary responsibility
OV93	=	Ocean Venture 93
PC	=	personal computer
PHIB CB	=	Amphibious construction battalion
POL	=	petroleum, oil, and lubricants
RC	=	Reserve Component
R&D	=	research and development

RDT&E	=	research, development, test, and evaluation
ROC	=	required operational capability
RO/RO	=	roll-on/roll-off
RRDF	=	RO/RO Discharge Facility
RRF	=	Ready Reserve Force
SLEP	=	service life extension program
SLWT	=	Side-loaded warping tug
SS	=	Sea State
S/T	=	short ton
T-ACS	=	auxiliary crane ship
TEU	=	20 foot equivalent unit
TOFM	=	theater opening force module
TPFDD	=	time-phased force deployment data
TRANSCOM	=	Transportation Command
USACOM	=	U.S. Atlantic Command
USCENTCOM	=	U.S. Central Command
USEUCOM	=	U.S. European Command
USPACOM	=	U.S. Pacific Command
USSOUTHCOM	=	U.S. Southern Command
USTRANSCOM	=	U.S. Transportation Command
VLCC	=	very large crude carrier

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This asssessment looks at Regional Unified Command Joint Logistics Over the Shore (JLOTS) cargo throughput requirements and measures them against the combined Army and Navy capability. The unified command requirements were translated from a gross tonnage requirement into tracked and wheeled vehicles and containers that are to be transshipped from ships offshore to the beach. We employed a new analytical tool, the LMI developed Joint Over the Shore Transportation Estimator, to select the craft best suited to perform a specific JLOTS cargo mission from among the various types of lighters assumed available to the Regional Unified Commands. Also reviewed were Service acquisition and research and development programs along with other emerging technologies to gage the future direction of the DoD JLOTS program. Pertinent information on sea conditions around the world was collected. This information was then used in modeling the effectiveness of the various Service lighters in performing the JLOTS mission. Our assessment concluded that all but one regional JLOTS requirement could be met; that force structuring issues involving the current ratio of Active to Reserve Component units require further analysis; that technology alternatives (Landing Ship Quay/Causeway, Advanced Modular Causeway Lighterage System, and robotic crane technology) be explored to overcome the sea state 3 limitation of the current JLOTS cargo transfer systems; that the Services and unified commands identify JLOTS requirements in the time-phased force deployment data; that deployment options be explored to position JLOTS lighters where they are capable of meeting time-sensitive unified command missions; and that the JLOTS force be trained during JCS-sponsored exercises.

14. SUBJECT TERMS

Watercraft and lighterage - Logistics Support Vessel; Landing Craft, Air Cushioned; Landing Craft, Utility; Causeways
CINC JLOTS requirements - the Joint Over the Shore Transportation Estimator
Sea State - conditions and lighter capability, emerging technology
Force Structure - Maritime Prepositioned and Afloat Prepositioned Forces, lighter crews, cargo-handling units

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